THE

ELECTRICAL REVIEW.

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THE

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ELECTRICITY IN H.M. NAVY.

WE suppose that to practical electrical engineers the paper by Mr. Alexander Siemens, and the subsequent discussion thereupon, were as interesting as anything electrical which came before the Dover meeting of the British Association. Both of these are printed in another column of this issue. The section was indebted to Mr. Siemens for bringing forward the subject of electrical machinery on board ship in the presence of the president, Sir Wm. H. White. If the paper had only been read expressly for the purpose of securing from the Admiralty's chief constructor a statement on the question in its bearing upon modern naval equipment, Mr. Siemens would deserve our gratitude. The author gave Sir W. White an opportunity to clear up certain doubts which have existed in some minds as to the wisdom of our Government construction policy of allowing electrical applications to take a secondary place on board our world-renowned battleships, and Sir William showed no reticence in disclosing what was the real policy adopted, nor did he hesitate to defend himself and his subordinate officials for the views which are held by them on this matter. The mistaken notion that Americans were first in the field with direct-driven generating sets was referred to. That this is far from being true is proved by merely mentioning the ridicule to which engineers who adopted direct coupling were subjected when they first placed several such sets on show at the Chicago Exhibition. One of Mr. Siemens's strong points in favour of the adoption of electricity for power purposes in marine vessels was the small amount of space occupied by electric transmission wires, as compared with hydraulic or steam pipes. These pipes might, or did, cause considerable trouble—leakage at the joints—a statement traversed both by Sir Frederick Bramwell and Sir W. H. White. Mr. Siemens's rejoinder on this point was particularly happy, and was fully appreciated by his hearers. If the pipes did not cause trouble by leaking, then they did by freezing. All precautions to prevent trouble occupy space, and no one will attempt to deny the extreme importance of space on modern vessels. Mr. Siemens exploded the suggestion that the Heilmann "central station on wheels" system could be applied to marine propulsion, and he dismissed the suggestion of accumulator propulsion by a calculation that a 6,000-ton vessel would require 40,000 tons weight of accumulators to take it across the Atlantic. This calculation was, of course, only made for the sake of introducing pleasantry. No one would have any doubt as to the sanity of any man who came forward at the present juncture with a proposal to employ accumulators in this way on the high seas.

We may not, perhaps, all agree exactly with the very slow progress which seems to have characterised the employment of electric motors on British naval vessels, and we must confess that the policy of caution, and slow but sure progress,

which was defended by Sir William, is that which has held us back in many other directions, although it may perhaps have been beneficial in the long run.

Foreign countries may make their sweeping revolutions in the power employed for both heavy and light work on warships, but British Admiralty officials having found hydraulic power so very reliable are wedded to it, at least as regards heavier work and for the time being. Sir William was very enthusiastic in his praise of hydraulic power, because it has been well tried, and is considered absolutely reliable; but he desires it to be known that he does not overlook the extreme convenience and other advantages which will result from the adoption of electricity. Electricity is used in our Navy for various purposes at the present time, but only for the lighter duties—the heaviest gun handled by electric power is that of a 9·2-inch calibre, but Sir Wm. White bids us be encouraged by remarking that electrical power having proved its practicability and convenience for that size, will go on to be tried for larger sizes, so that in time the progress for which we are all hoping will be made. We cannot help, as Englishmen, having great respect for the national policy of caution, but we are inclined to think that the enormous advantages of convenience and economy of electric power have not been altogether appreciated by the Government department in which Sir W. White plays so important a part. A factory is not perhaps on all fours with a warship, but electrical transmission ought to acquit itself admirably under the circumstances to be met with in either sphere of action, although for marine service, as Sir Wm. White indicated, specially designed water-tight fittings are, of course, essential.

FIGURES RELATING TO ELECTRIC TRACTION.

For some reason or other there has been always more or less difficulty in obtaining actual details of cost relating to the operation of electric tramways, especially when they have been owned by English concerns. Even the actual cost of constructing a line is more or less shrouded in mystery. Probably more publicity prevails in America, and it can hardly be said that much harm has been done by the publication of financial statements; on the contrary, nothing but good could possibly result, and it is very much to be regretted that more information is not available. Electric tramways have been in operation in several English towns for some time, but it is hopeless to endeavour to ascertain the cost of working. It can hardly be said that the systems are in any sense a failure, because the receipts show the contrary. In no instance is it more regrettable than in the case of the Birmingham accumulator system, to which reference is made in another column. As far as we can learn, Continental authorities are as reticent as those at home, and consequently one is compelled to obtain information regarding operating cost from the United States. Some time ago a writer in one of our American contemporaries published some interesting figures, which were practically based on an analysis of nearly 50 power stations. In order to arrive at the real value of the figures of any good tramway system, the writer (Mr. R. W. Conant) made a standard of reference, and then compared the working of the various systems with that of a standard system operating under the most favourable conditions.

An equipment of a standard station is assumed to consist of three 1,200-kw. steam dynamos, and six 500-h.p. water-tube boilers with the usual accessories, the estimated costs being as follows:—

Building foundations for machinery, chimney, coal handling apparatus	£25,000
Engines and condensers, heaters, superheaters, and piping...	19,135
Feed pumps and economisers	3,750
Boilers and flues	12 700
Generators and switchboards	15,375
Land and docking facilities	3,540
Engineering sundries	1,040
	£80,540
Cost per kilowatt capacity	£22·4

On the basis of an annual output of 10,500,000 kw.-hours, with a load factor of 33·3 per cent., the working expenses are:—

Interest, depreciation, and taxes	0·20d.
Labour	0·08d.
Fuel, at 14s. per ton	0·16d.
General expenses	0·05d.
Total per kilowatt-hour	0·49d.

The usual fixed charges, cost of fuel, cost of labour, and general expenses are roughly in the ratio 4 : 4 : 2 : 1.

It is apparent that these figures are not likely to be achieved in actual practice on many occasions, because electric tramways are not often carried out under the most favourable conditions; but they ought to prove of interest in affording a standard. Moreover, in the inquiries made among the American stations, Mr. Conant found that at three existing stations the working cost per kw. hour is less than that given for the standard station.

It is not likely, with the growth of municipal tramways, that we shall very long suffer from a dearth of working costs, though whether we shall be able to obtain information as full as that provided by electric lighting returns remains to be seen.

While we are upon this subject of tramway operation costs, it will be opportune to make reference to the figures which have recently been issued by the Metropolitan Tramway Company, of New York, showing the comparative costs of horse, cable, and electric conduit lines in that city. Figures of a similar character were published by the same company for the previous year's working, and were referred to at length in the Electrical Review. It will also be remembered what a large amount of interest was excited in tramway quarters in this country by the free circulation of the figures on this side.

The Metropolitan Company, of New York, have under their care the three systems of traction above enunciated, and the *Street Railway Journal* gives a full table of the receipts and expenses of each system for the year ended June, 1899. Electricity earns most per car-mile, costs least in maintenance of way, is heaviest by a small amount only in equipment maintenance, and is by far the lowest in power cost. The total operating expenses by electricity are thus very much less than those for either rival system.

The three systems in the order named are operated on a track mileage of 25·3, 82·1, and 113·4. Since the previous financial year the car mileage on the same tracks had

increased from 35 to 42 millions, and receipts had gone up 25 per cent., car-mile receipts springing from 29·7 to 30·7 cents. The whole Metropolitan system was operated at a cost of 15·18 cents per car-mile, and earned a net 15·5 cents against 13·87 cents the year before, and all the increase is due to electricity, for the other systems earned less per car-mile than they had done the previous year. The percentage of operating expenses was respectively 50·8, 38·3, and 69·8.

It appears that during the stormy part of last winter a new cable on the Broadway line would hardly last more than a week. The actual cost of electric motive power per car-mile was 1·57 cents, or, say, ·785d., against ·605d. the year before; but the new 70,000-H.P. station is not yet at work. It is expected to give better results than the numerous present temporary stations and storage batteries. The figures kindly published by this great New York company are of special interest. They show in bold type what electricity will enable to be done.

Engine Guarantees.

THE *Engineer* is evidently spurred on to write an article on this subject by the attention that has been called to the subject of guarantees through the Glasgow contract. Our contemporary rightly minimises the value of guarantees, pointing out that in traction work especially, the guarantee must be worked off under conditions which never obtain during the working life of the engines. It is easy to guarantee a steam consumption, because in very few cases can the conditions of the guarantee be supplied, and there are a score of influences at work to prevent the actual guarantee from being secured. The less scrupulous the contractor is, the more easily will he give impossible guarantees, *and rely on tactics of delay to prevent even the shadow of a test being even carried out.* The whole question of performance is, to our mind, beclouded by an imperfect realisation of what can be done to secure economy. Given steam of equal quality, a dozen engines from the same maker will give as many different results according to their finish. The economy of an engine may be varied by the material of its piston faces and cylinder ports, their roughness, &c. The fit of a deep cylinder cover is capable of making a very serious difference. We are inclined to think that in aiming at economy an engineer should secure from tenderers a drawing of the cylinder ends, valves and ports, and an agreement to give a certain finish to these parts. This done, and every effort made to secure economy, the rest is a mere matter of pressure and expansion, of suitability of an engine for its duty. In our contemporary's article too much mystery is made of the performance variations of engines of the same pattern, as though the cause was unfathomable. It is not usually very occult, but it is a fact that very small apparent faults will cause great losses. A slight fault that hardly shows itself to an ordinary observer on an indicator diagram may easily make a difference of 15 per cent. in steam consumption. We think, too, that few advantages are really got by means of a complex and expensive valve gear. True, we know some very complex valve gears, but we generally ascribe these to the overweening conceit of some fiend in mechanism who has let his ardour for mechanical movements get the better of his common sense. We think engine buyers should consider first the pressure they dare work at, the reputation for the firm they deal with for good workmanship, and the ability of their consultant to ask for details and demand a finish that is likely to make for economy. To turn an engine outside in as regards the polish of surfaces may bring at once an initial saving of money and a permanent saving of fuel. Yet how very little attention is paid either to the polish of inside surfaces or to the reduction of such surfaces to a minimum! These items have been preached upon by practical engineers for long years enough, but very little has yet been done towards carrying them out.

The Public and the Supply of Electricity.

THERE is little doubt that when the Public Electricity Works changed over their supply of electricity from 100 volts to 200 volts pressure, they did a good thing for themselves; but we are afraid the consumers have not always shared in these benefits, on the contrary, they have in some instances suffered materially from the change. Practically the supply systems, by adopting 200 volts, were able to quadruple the carrying capacity of their mains, and though it was little short of an engineering triumph, it is doubtful whether it will bring much advantage to the Electric Lighting Works until the disabilities of the consumers have been removed. The hardships that are placed upon a consumer by compelling him to accept a service at 200 volts pressure are sufficiently obvious: he is compelled to employ a better class of fitting, but most important of all, it is necessary for him to use 200-volt lamps, which are more expensive and less efficient than those made to burn at 100 volts. It is true that the supply companies, when introducing 200-volt supply reduce their charges, but the gain of a consumer is diminished if he is compelled to use more electricity. Under the circumstances it is not surprising that complaints from consumers should have been rife, and in more than one instance electric lighting has been abandoned for this reason alone. There are, however, methods by which the burden of the consumer may be lightened, and the bold policy of one municipality which gives lamps to all consumers has much to recommend it. The improvements that will be without question effected in 200-volt lamps will minimise the defects of the system; but in the meantime it is incumbent that the consumers should receive a little more consideration at the hands of the Electricity Supply authorities. The question has been raised as to whether a supply company can compel a consumer to accept a 200-volt supply; the companies have apparently acted on the assumption that they can, but we doubt whether their position could be maintained in a court of law. It is to no one's interests that any embitterment should be established between the suppliers and the consumers, and it is to be sincerely hoped that a *modus vivendi* may be found.

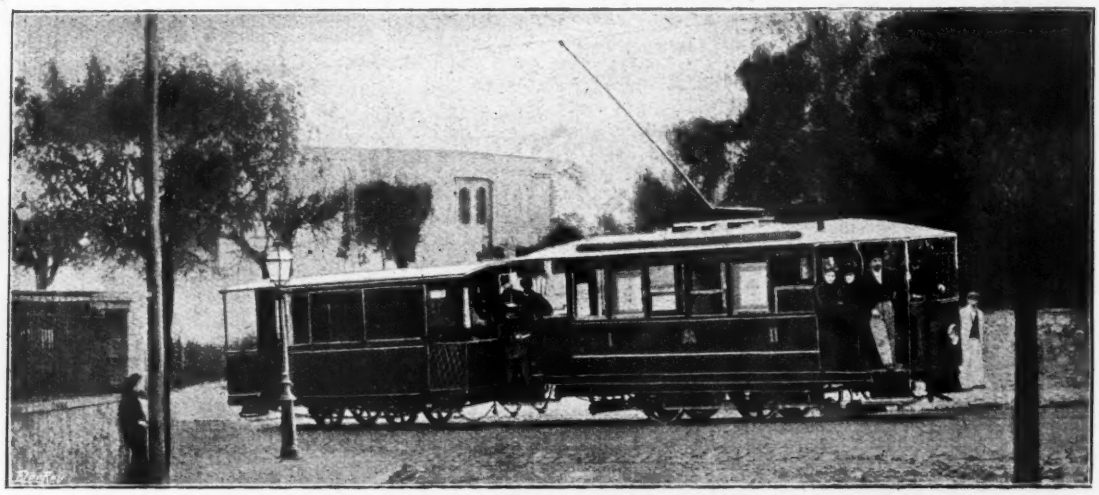
Electric Tramcar Mishaps.

THE frequency with which mishaps of one kind and another have recently been occurring on the Dublin electric tramways system is not calculated to benefit the cause of electric traction in towns where schemes are now under consideration. Some of the accidents may have been of extreme unimportance, but nevertheless they serve along with the more serious ones to cause alarm to the populace, which is by no means satisfactory. We therefore feel that the Board of Trade has been well advised in deciding to institute a complete investigation on the spot as to the cause of the recent occurrences. Mr. A. P. Trotter, whom everyone in electrical circles here is pleased to see back in this country, is conducting the inquiry, and we imagine that he will go very exhaustively into the matter. Several points occur to us as demanding attention, one of the principal being the necessity for efficient management of the cars. The human element is by no means an unimportant one, and there are, we believe, certain parts of the Dublin routes where great care is required in the manipulation of cars to prevent trouble arising with the other traffic. But we may trust to Mr. Trotter sifting the matter thoroughly, and we shall look forward to his report in the interests of electric traction.

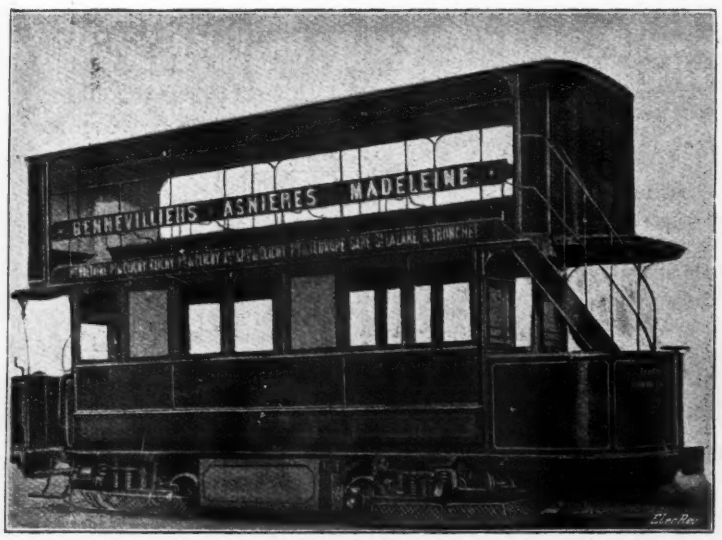
D

ELECTRIC TRACTION IN PARIS.

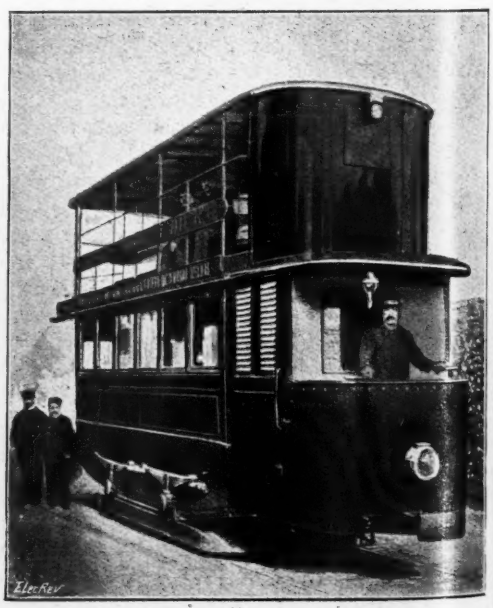
Paris has been the scene of a great variety of mechanical traction trials. Almost every conceivable method of electric tramway propulsion has been tried there during recent years, including cable, gas, compressed air, steam, electric trolley, surface contact, accumulator, and underground electric conduit systems. In this Paris does not differ to any very great extent from what London may be expected to become in a year or so, when the London United trolley and conduit systems, and the L.C.C. surface contact and conduit lines, with trolleys for the outskirts, may be at work. We have had steam lines, and have now some worked by cable, which will perhaps in due course, follow the example of the majority of such lines in America, and change over to the more economical and convenient system of electrical working; but compressed air certainly is at present not used on any London service, nor, we are sorry to say, is the accumulator. In some ways we had almost wished that, in reporting upon the traction question, accumulators had not been so sweepingly cast aside as out of the question. The mixed system has not been altogether unsuccessful abroad, and when we take into account the great improvements that battery makers have effected of recent years in their products, decreasing weight for a given capacity, increasing mechanical strength and reducing prices, and also the attention that has been devoted by those working accumulator lines to the easier handling of the batteries in their removal from the cars when discharged and subsequent replacement—when these things are looked at it certainly appears that things are gradually moving in the direction of accumulator traction for the crowded thoroughfares where the trolley is thought to be inadmissible because of its overhead work, and the conduit because of its slot and heavy initial cost. We have not in view any revolutionising invention or change in battery traction, for, so far as we are aware, none is at hand, we are only anxious that accumulator traction should not be overlooked as unworthy of consideration for such problems as London, Newcastle, and other busy cities have been recently considering. Some time ago statements were made as to remarkable success resulting from the operation of the Birmingham Tramways Company with a new type of accumulator; not new to the electrical world, but newly tried in traction work at Birmingham. We wish that those excellent results could be made public in all their details, giving the cost per car-mile, the cost of maintenance, the initial cost of the equipment, together with notes of the efficiency or otherwise of the working. If the



Trolley Car with Trailer, Paris.



Accumulator Car, Paris.



Surface Contact Car, Paris—Romainville.

results were so good as we were led to believe, it seems difficult to understand why the figures should be suppressed or held back. It would be decidedly to the advantage of the maker of the particular battery if he could show results so vastly superior to the attempts of his predecessors, and it might have an effect upon the future of electric traction in towns.

We read in an American exchange of the extension of the Chicago and Englewood storage battery system. This fact alone points to success, and we think the present moment an opportune one for reproducing from the columns of our contemporary an illustrated description of the equipment. It appears on another page in this issue.

The *Street Railway Journal*, of Chicago, recently published an illustrated article noting what has been done in Paris in the way of electric tramways, and we are indebted to our contemporary for the notes and illustrations which follow:—

There are three companies which operate electric railways in the city of Paris—the Compagnie des Tramways de Paris et du Département de la Seine, the Compagnie Générale Parisienne de Tramways and the Compagnie du Tramway de Paris à Romainville. The principal line leaves from in front of the Madeleine, in the centre of Paris. The power station is situated on the line of the road at Asniéres, and contains three engines, each connected to a Walker 200-KW. generator. Two types of cars are used, a single and double truck. The double-truck car, which is mounted on Brill maximum traction trucks, carries 58 passengers, and weighs, complete, 17,000 kg., made up as follows: weight of car body, 4,200 kg.; trucks and motors, 4,700 kg.; battery, 3,700 kg.; 58 passengers and two employés, 440 kg. The car operates on the mixed trolley and accumulator system.

The Compagnie du Tramway de Paris à Romainville operates cars from the Place de la Republique, at the centre of Paris, to the Port de Romainville, and thence to Coté de Noisy-le-Sec. The line was installed in 1896, is equipped with Claret-Vuilleumier surface contact system. The length in Paris is 4 km. of double track, and outside of Paris 3 km. of single track. The minimum curve radius is 25 metres, and the steepest grade is 5½ per cent. The power station is situated at Lilas, about two-thirds of the distance from the Paris terminal. It contains three boilers, four Corliss engines, four generators, and adjoining it is a car house for 30 cars. The cars are capable of carrying 52 passengers. They weigh 13,000 kg. loaded, and are operated by two 30-H.P. Walker motors.

The Compagnie Générale Parisienne de Tramways has a line 6·2 km. in length, part of which is operated by the trolley system and part by the underground conduit. There are 17 motor cars, each equipped with two General Electric motors. The power station contains three Thomson-Houston 200-KW. generators.

The Compagnie du Tramway Raincy à Montfermiel, while not in Paris, is not far from it, and it is proposed to extend the road into the city, by way of Romainville. It extends from Romainville to Montfermiel, has a length of 7 km., and is equipped with the trolley system. There are 10 motor cars, weighing 12,500 kg. each, equipped with two 25-H.P. Walker motors.

The *Revue des Transports Parisiens* recently summarised the Paris tramway companies as follows:—There are nine companies.

1. Compagnie Générale des Omnibus.—On January 1st this company had 184·7 km. of track laid with Marsillon rail, 9·3 km. laid with Broca rail, 15 km. laid with Vignole or T rail, and 23·3 km. laid with "American" or strap rail. The company has 14 Rowan (steam) cars, 54 Mekaraki (compressed air) cars, 59 Serpollet (steam) cars. The company had 4,800 horses on July 1st, 1898.

2. Compagnie des Tramways de Paris et du Département de la Seine.—This company has 79·9 km. of track laid with Broca rail, and 29·7 km. of track laid with Vignole rail, all operated by mechanical power, viz:—Lamm Francq (fireless) locomotives, Serpollet (steam) locomotives, accumulator cars, and, for a short distance in the outskirts of the city, a trolley line. The company has 20 Lamm Francq locomotives, 22 Serpollet motor cars, which are being replaced with accumulator cars, 55 accumulator motor cars, 28 motor cars for a mixed trolley and accumulator service, and 5 trolley cars.

3. Tramway à Vapeur de Paris à Saint-Germain.—This company has 17 17-ton dummies.

4. Funiculaire de Belleville, the Belleville Cable Railway.—This road is 2 km. in length, laid with Broca rails, and has 21 cars.

5. Compagnie Générale Parisienne de Tramways.—This company has 111·9 km. of track, of which 60·9 km. is laid with Broca rails, 32·4 km. with strap rails, 9·8 km. with Marsillon rails, and 8·8 km. with Vignole rails. The company has 154 cars, all worked by horses, with the exception of a short electric line, most of which is trolley, but a short portion is underground conduit.

6. Compagnie du Chemin de Fer de Paris-Arpajon.—This company has five compressed air locomotives and 21 steam locomotives, but is proposing to instal an electric system on part of its line. The track is laid with Broca, Marsillon, and Vignole rails.

7. Compagnie des Chemins de Fer Nogentais.—This company has 17·3 km. of track, and owns 19 compressed air motor cars, and 10 trail cars.

8. Compagnie des Tramways de Saint-Maur.—This company has 12 km., and owns 10 compressed air motor cars and eight trail cars. The line will be equipped with the trolley system soon.

9. Compagnie du Tramway de Paris à Romainville.—This company has about 7 km. of track, and operates 20 electric motor cars on the Claret-Vuilleumier surface contact system.

In addition, an electric line will be started during the year by the North and South Tramway companies. The trolley system will be used outside of Paris, and the conduit system within the city limits.

THE INSTALLATION OF STEAM BOILERS.

VIII.

Having now reviewed the general arrangement of a boiler and its seatings, there remain to be considered its accessories, and it can hardly be said that these, in the aggregate, have less claim upon our care and attention than the boiler itself, for no matter how well a boiler may be made, or how strong it may be, these qualities will surely be endangered, or put to nought by failure in the accessories. A locked-down safety valve may burst any boiler, as recently happened at Barking, where the condition of the valve was either caused or obscured by the fault of the pressure gauge. In dealing with accessories, we may, perhaps, best commence with the feed inlet, finishing with the blow-out apparatus, thus following approximately the course of the water. At one time boilers were very commonly fed at their lowest points—even, at times, through a branch on the blow-out pipe. This method had two principal faults. The admission of cold or cool water to the bottom of the boiler caused very severe stresses in the shell bottom, and was a fruitful cause of seam rips. When anything went wrong with the pumps, or the feed check valve failed, or became leaky, and possibly, also, there was a leaking flange in the feed pipe, the pressure in the boiler was capable of emptying it of water through the feed inlet. A broken feed pipe and a check valve out of order would endanger the furnace crown very quickly. These faults combined brought about an alteration in the position of the feed inlet, which either fault alone was bad enough to demand. Although the feed inlet may be by a suitable block on the crown of the boiler, or through the back end plate, the modern approved position is on the left side of the front end plate, at a height of 5 inches or 6 inches above the level of the furnace crown, and at a distance from the centre line of the boiler equal to the furnace diameter. This position effectually prevents the reduction of the water level below the furnace crown, in case of accident to the feed pipes or valves. The feed valve, which serves as a check valve, also being loose on its spindle, is attached by a flange and studs to a faced block riveted to the front end plate. Studs screwed to the inside of this block serve to attach inside the boiler an internal distribution pipe, 15 to 20 feet in length, and perforated in the last length of 5 feet. It should be 2½ inches inside diameter, and it must be carried by a suspender each 5 feet, consisting of a hook of ⅞ round iron, screwed and nutted, and attached to an angle bracket riveted by two rivets to the shell, as in fig. 23. Being in lengths of 5 feet, the pipes are easily removed for cleaning. The valve should be of the external nut and pillar type, and it should have a stop on the screwed spindle, to prevent too wide an opening being given, and danger of setting the valve free of its seating. Externally, the feed pipe should preferably come to the valve from above. It is bad practice to lay the feed pipes in the hearth pit, incommoding this, and rendering the pipes liable to corrosion.

The feed main should be suspended above the front of the boilers, and branches placed over each boiler, from which a down pipe is carried to each valve. As the opening to the valve is always from below, this down pipe terminates in a half-circle bend, and a good finish is given to the work, for

this bend is of $\frac{1}{8}$-inch solid drawn copper. These allow also for slight movements of expansion.

The feed mains may be hung by long suspension rods from the roof above attached to the pipe by a clip of 2 inches × $\frac{1}{4}$ inch iron, with a $\frac{5}{8}$-inch bolt and an eye on the end of the

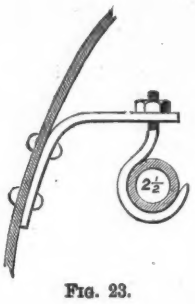


Fig. 23.

rod, which should be of $\frac{1}{2}$ inch round rods, spaced two to each boiler, or of $\frac{5}{8}$ rod if only one suspender is used for each boiler.

With pipes thus arranged, there is no invisible joint. The height of the feed main may conveniently be such that the straight down pipe is 5 feet long. Where not of copper, the feed pipes should be of wrought-iron or steel, but the internal distribution pipe may be of cast-iron. The feed main usually connects on to the outlet of the economiser, but it may also have a connection from the feed pump direct, and where it can be arranged the two valves for these two connections ought to be near together and painted red and blue respectively. Generally it is a good plan to distinguish connections of a duplicate order by colour.

As we are upon the subject of an attachment to the front end plate, the scum tap may be here named. It is attached to the opposite side of the front end plate to that occupied by the feed valve, and in the same relative position. Inside the boiler the scum pipes are similarly attached, and suspended by a hook, as in fig. 23. Their length is usually 15 feet in three 5-feet pieces, flanged together. They consist of 2-inch pipes, with

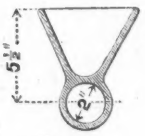


Fig. 24.

a trough 4 feet 6 inches in length cast upon each pipe, and the trough is about $5\frac{1}{2}$ inches deep to the centre of the pipe from the upper edges of the trough. The sides of the trough incline from each other at an angle of 60°. At the bottom of each length are three slots of 1 inch × $\frac{1}{2}$ inch. The trough for its full length is to be set perfectly horizontal with its edge half an inch below the water level pointer. It should be blown only when the water in the gauge glass is at the pointer level when the troughs will perform their duty of skimming off the surface of the water and any floating matter or froth. The pipes are connected by faced flanges. The scum tap itself may be of parallel slide valve type, or it may be a gun-metal cone tap discharging below. It is usual to take the waste pipe down into the hearth pipe and connect to the waste main by a band of copper for the sake of elasticity. The same remarks apply here as in the case of the bottom blow-out cock in respect of independent waste pipes. The single waste main has the merit of convenience, and in many cases is imperative, but when it can be avoided there are good reasons for doing so.

In reference to the remarks about the desirability of using specially moulded blocks for the contact surfaces of the front cross wall on the boiler shell, Messrs. Poulton and Co., of Reading, the patentees of curvilinear blocks, have written to say that they make these blocks as well as the seating blocks of their patented forms. They also make a seating block which serves equally well for either a seating block, or if turned through an angle of 90°, for side flue cover blocks. In fact, at every point of contact with the boiler of the external brickwork or the internal bridge work of the furnace, Messrs. Poulton & Co. provide a special form of brick to minimise the concealment of the plates.

ACCIDENT AT MANCHESTER CORPORATION ELECTRICITY WORKS.

We give below an authoritative version of the disaster of which we gave a brief account last week:—

At about 6 p.m. on Tuesday, the 19th inst., a belt broke on one of the 400 H.P. sets. There are 12 of these sets, comprising side by side compound condensing engines, running at a speed of about 80 revolutions per minute. They drive 240-KW. dynamo machines by means of leather link belts, the drive being shortened by means of jockey pulleys. Ten sets were running at the time of the accident; none of them were overloaded. The belt on one of the sets broke half-way across; the dynamo was switched out, and the steam shut off at the stop valve and the vacuum broken, but before the steam valve could be shut, the broken portion of the belt carried away the governor in its entirety, and the engine having full steam with no load immediately raced, attaining a very high speed. Simultaneously with the shutting off steam, the stress on the fly-wheel caused it to burst, and in so doing it wrecked the engine next to it, the fly-wheel of which was in the same plane as the first one which burst. The fragments of both fly-wheels were thrown to considerable distances, and owing to the great strength of the building they glanced off and damaged plant situated at some distance on either side of the engines, as well as what was directly in what might be expected to be the line of flight. Considerable damage was done to the building, the roof, and other plant; the two engines and the dynamos which they drive, together with their jockey pulleys, were completely wrecked.

The engines were fitted with automatic knock-off for excess speed, but owing to the carrying away of the governor, this was, of course, of no avail.

The supply was completely interrupted on account of the steam and condensing water pipes being disabled. The steam ranges are in complete duplicate, but the steam connections to the engines were smashed, one on each range, so that both were discharging live steam through a 7-inch pipe. The condensing water range, which comprises a 20-inch cast-iron pipe, not in duplicate, had a triangular hole about 4 inches across knocked in it, and a length of about 10 feet was completely shattered, though the pieces held together. Three of the engines only were arranged to work with atmospheric exhaust, and even this exhaust pipe was smashed so as not to be available.

Blank flanges were rapidly fixed on the branches to the engines, and the two steam pipes got under steam, but the supply could not be re-established owing to its being impossible to run the engines non-condensing. It was, therefore, necessary to in some manner temporarily repair the condensing water pipe; the means adopted may be of interest.

As already stated, the damaged pipe was a cast-iron one, some 20 inches in diameter. Some stout asbestos millboard was first laid over the hole and over the worst cracks, this was then bound round with the tape used for insulating electrical joints, then with canvas, and finally with spun yarn. The whole pipe and its wrappings was then entirely surrounded with a wooden box, having its ends cut to fit round the pipe. This box was then completely filled with the bitumen used in laying cables on the solid system. On turning on the water it was found that the means adopted were successful, and although the pipe leaked to a substantial extent, it was quite useable. The supply was re-established at 4.15 a.m. on the following morning, after having been interrupted for 10¼ hours.

Our first impression after reading the above is one of astonishment that such a slight incident as the breaking of a belt should lead to so serious a chapter of accidents—two engines wrecked, other plant damaged, steam and exhaust pipes and water pipe smashed, and the supply interrupted for 10 hours! Human foresight could hardly have been expected to anticipate all these items; and yet it ought not have been possible for them all to happen at once. It is easy to be wise after the event; but there are one or two questions which at once arise in one's mind. For instance, why were the engines wholly dependent upon the condenser, except in the case of three of their number? It seems somewhat absurd to duplicate the steam and feed pipes throughout, and yet to rely entirely upon a single water supply pipe for condensing, without even providing means for exhausting to the atmosphere! The latter provision, we should have thought, would under no circumstances have been omitted. Then again, in the case of those engines which were furnished with the alternative exhaust, why were not the pipes carried beneath the floor level? This is certainly the most convenient way of installing them, besides securing good drainage from the cylinders, and it is comparatively rare to find them carried overhead nowadays.

To criticise the archaic arrangement of belt-driving, with

a short drive and a jockey pulley, is somewhat superfluous; the method was so freely criticised—and condemned—years ago, that we can add no new arguments to those already used. We cannot imagine any engineer carrying out extensions, still less new work, on that obsolete method. The fact remains, however, that several generating stations have been in past years equipped on this system; and it must be admitted that the belt was the prime cause of the whole series of disasters. We have often claimed for this country pioneer honours in direct coupling of engine and dynamo, while we have chaffed our American friends on their alleged habit of bursting fly-wheels; alas! what can we say now?

We are glad to think that the new 1,500 H.P. E.C.C. generator recently erected is direct-coupled to its engine, but it was apparently no better off as regards exhaust than the others. No doubt this error will be remedied before the large Siemens set is installed.

The ingenious method adopted for effecting a makeshift repair is noteworthy, and we must congratulate Mr. Wordingham and his assistants on their prompt restoration, under the circumstances, of the supply.

Since writing the above we hear that another interruption to the supply took place, on Sunday evening, due to a defect in the mains. The fault was made good in two hours' time and supply resumed.

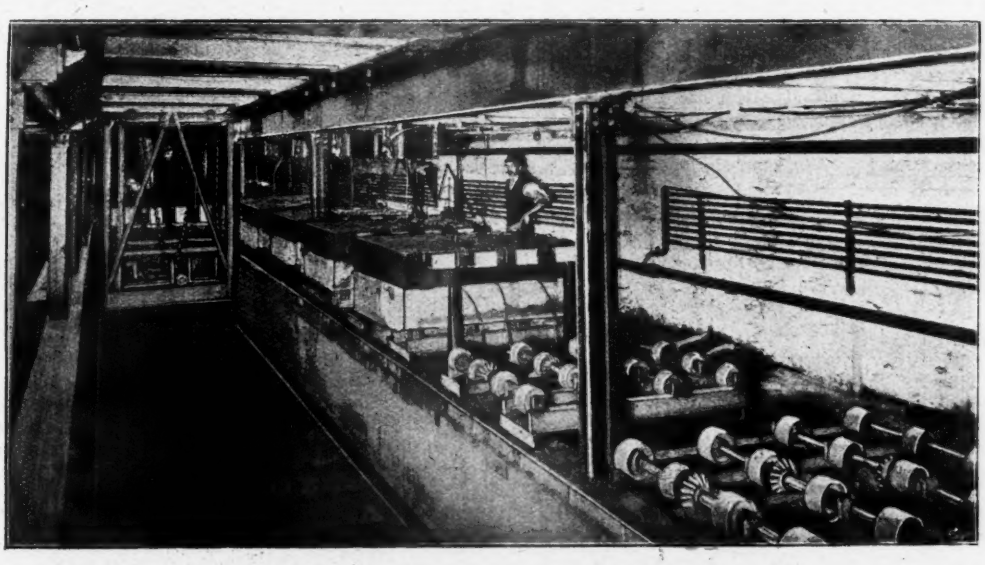
THE ENGLEWOOD AND CHICAGO STORAGE BATTERY LINE.

The storage battery cars on the line of the Chicago Electric Traction Company, formerly known as the Englewood and Chicago Street Railway Company, have now been running a little more than two years, and are said by the management to be handling the traffic in a satisfactory manner. It is not claimed, however, that cars can be operated more cheaply by the storage battery than by the overhead trolley system, but that for suburban lines of this character, or in cities where the overhead trolley is not allowed, the storage battery provides a very efficient and acceptable method of electric traction. The cost per car mile for operating the system in 1898 was 8·7 cents, and during the month of August it was as low as 7·2 cents. This year it is a little higher, owing to track repairs, which were not required during the first two years of service.

We are indebted to the *Street Railway Journal*, Chicago, for the following description and the accompanying pictures:—

The original equipment of the line embraced 24 miles. The main system extends in a south-westerly direction from Sixty-third Street and South Park Avenue to the village of Blue Island, with a branch running to Morgan Park. On this branch is a 9 per cent. grade, up which the cars are assisted by a balance weight system designed by M. H. Bronsdon, of Providence, R.I. The system has recently been extended as a single track line a distance of 5 miles to Harvey, and the cars are now running through to the latter place, where a small power station has been erected. The company has in regular operation 25 cars, for which 40 batteries are provided. The latter are of the Electric Storage Company's type, manufactured in Philadelphia, and what are known as the Manchester plates are employed.

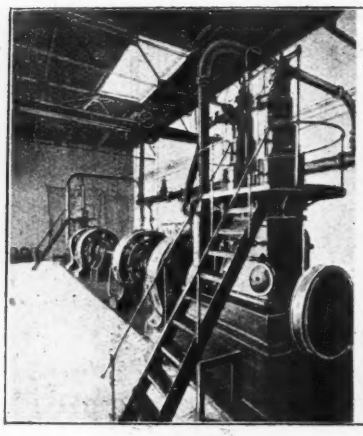
Each battery is composed of 72 cells, arranged in a tray, by means of which it is shifted about or removed or replaced in the car. The weight of each battery, including the tray, is about three tons. The cars are mounted on Dupont trucks. The battery is carried in the middle of the truck between the axles, and is removed and replaced from beneath. A 525-lb. wheel and a 4-inch steel axle are employed. Each car is equipped with a 50-H.P. Walker motor, which is mounted outside the axle, and during the hours of excessive traffic each motor car hauls a trail car. The distance travelled by one charge of battery is 11 miles. A much longer distance can be run when necessary, but about this distance is regarded as the most economical. Each cell of the battery is charged to an E.M.F. of 2·18 volts. In the trip of 11 miles this is reduced to 2 volts, and it is seldom that the batteries are reduced below this rate. The life of the positive plates of the battery is sufficient for a distance of 23,000 miles, and the negative plates for about twice that mileage, or the negative plates will usually outlast two sets of positive plates. The plates are run until the surface is too much reduced by the dropping out of the active material from the grids. Worn plates are not repaired, but the waste material, in the form of fine powder, is sold to the junk dealers. In service the plates do not buckle, but it is found to be of advantage to thoroughly wash and clean them after making about 4,000 miles. The electrolyte is composed of distilled water with chemically pure sulphuric acid at a density of 12·25. This is found to be reduced by 15° on account of spilling and evaporation in about three weeks, when the cells of each battery are replenished and the fluid is brought up to the standard.



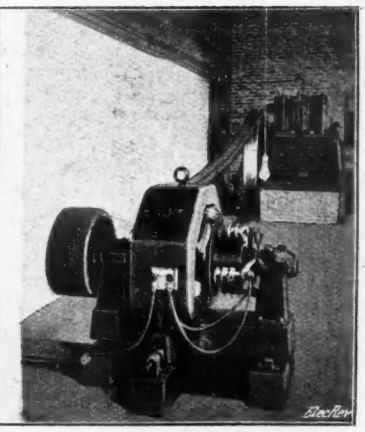
Storage Battery Pit and Shifting Car.

The main power station is located at Eighty-eight Street and Vincennes Road, about 5½ miles from the northern terminal of the line, and the most interesting feature of the station is the arrangement and location of the batteries, and the method employed for shifting and replacing. The battery pits occupy two long rooms in the basement, as illustrated on this page. These pits extend under the car-

house in a line at right angles to the car tracks and the street tracks, which pass in under an alcove extending in front of the station. Each battery pit is provided with a sunken way, in which is a track over which a shifting car operates. There are two of these cars, one in each pit. Each tray of battery is located on a nest of rollers, as shown in the illustration, which are connected by a system of shafting and bevelled gear, the main shaft terminating in a clutch at right angles to the line of the tracks. The shifting car is constructed of a steel framework, is equipped with five motors, and is controlled by levers arranged at the middle section of the car, as shown. At each end of the car is a platform equipped with rollers, the same as those for supporting the batteries in position. This platform is fitted with an elevating apparatus, by means of which the exhausted battery is removed and a fresh battery substituted. For loading the battery on the platform, the car is run into position, when the shaft on the car platform is automatically coupled to that supporting the battery; the shaft is then revolved by the car motor and the battery rolls forward on to the car platform. The car is then run down the line directly under the shifting pit, when the vacant platform is raised, and the exhausted battery lowered from the car. The battery or shifting car is then moved forward, bringing the fresh battery directly under the shifting pit, when this in turn is elevated and automatically hooked into the truck, while at the same time the connections are automatically made by contact springs, located on the sides of the tray. The platform is then lowered, and the replenished car proceeds on its course. An expert in handling the shifting car has been able to remove and replace a battery in 28 seconds; ordinarily it requires about 1½ minutes. The exhausted battery is returned and shifted to the charging stand in the same manner as described for loading.

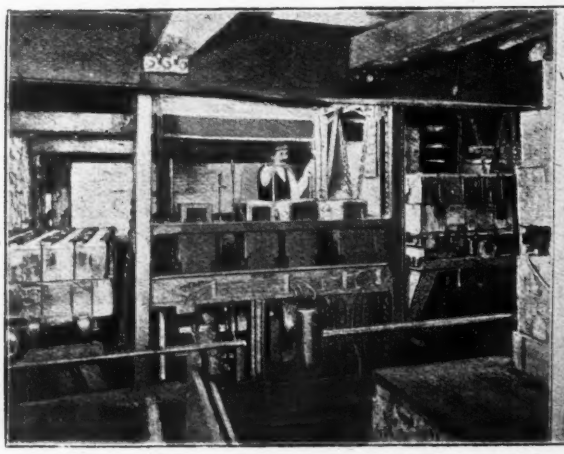


Main Power Station.

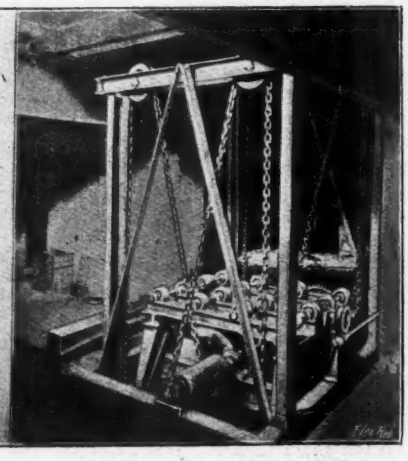


Harvey Sub-Station.

All the appliances for charging and shifting the batteries have been designed on very ingenious and economic lines, and it is hard to conceive how they can well be improved upon, as no hand labour whatever is required in shifting or in making connections for charging. In charging the batteries a current of only 160-volt pressure is first employed. Afterwards this is raised in stages to 170 volts, and finally to 180 volts. The motors are wound for operating normally under 135 volts pressure, but have never been injured by the ordinary voltage delivered from the battery. During more than two years of service no repairs whatever have been required on the motors. The manager would prefer to have two motors to the car, especially for winter travel, and it is the intention of the company to provide two motors on all new cars. As it is, only a little difficulty is experienced in keeping the cars operating during snowy weather. The snow ploughs and sweepers are equipped with three sets of batteries, and are as efficient as the trolley sweepers in keeping the tracks clear from snow and mud. The power equipment of the main station consists of two 250-H.P. Willans central valve high speed engines and four 250-KW. Walker generators. The engines are vertical, triple expansion, condensing, and run at 380 revolutions per minute. One is placed at each end of the engine room, and they are connected by a system of hollow shafting and clutches so that either one of the engines can be made to operate either or all of the four direct coupled generators, one engine and two generators being regarded as a unit, however. In charging the batteries three circuits are employed, as above described, so that one generator may be run at 160, the second at 170, and the third at 180 volts. When only two generators are run, the voltage is 166 and 178. During the time of light loads only one engine is run, but for heavy traffic both are employed.



Battery Shifting Car.



End of Shifting Car.

These engines were made by the M. C. Bullock Manufacturing Company, of Chicago, and are of the same type that this firm had running on exhibition at the World's Fair in 1893. They have been in constant service in this storage battery plant since it was installed in 1896, and are still working without any apparent depreciation. Each engine, as illustrated, is really a double vertical engine, and each half consists of three tandem cylinders, or is a tandem triple expansion single action engine, with central simple valve gear, with a fourth cylinder at the base, which acts as

an air cushion. An important and particular feature of this type of engine is the drainage arrangement, which is accomplished by having the pistons dished downward in the centre, while the hollow piston rod has a ring of ports flush with the surface of the piston, being in the best possible place for drainage. This feature is claimed to make a saving of at least 15 per cent. in the steam consumption, as there is no water left in the cylinder to rob the incoming steam of its heat during the period of admission. Paradoxical as it may seem, the piston speed, 500 feet per minute, owing to the short stroke, only 8 inches, is slower than in so-called slow-running engines. In these engines the diameter of the three cylinders is as follows: Low pressure, $23\frac{5}{8}$ inches; intermediate, $14\frac{15}{16}$ inches; high pressure, $10\frac{1}{4}$ inches. The engines run entirely noiseless, and the governing features are unusually sensitive and efficient. Among the claims for this type of machine are durability, economy, and safety.

The boiler equipment consists of three 200-H.P. Heine boilers, provided with Roney mechanical stokers. Jet condensers are employed, and there is a cooling tower, installed by the H. R. Worthington Company, which consists of a steel tank 30 feet high and 12 feet in diameter. This is partly filled with vitrified sewer pipe placed on end so that the water when pumped to the top of the tower trickles over the pipes to the tank below. The cooling blast is provided by a large fan operated by an electric motor, which serves to cool the water that it may be used over and over again for condensing purposes.

The new power station at Harvey is equipped with a 50-H.P. Nash triple-cylinder gasoline engine, manufactured by the National Meter Company, of New York, run at 250 r.p.m. This is belted direct to a 40-KW. Eddy generator, manufactured by the Eddy Manufacturing Company, Windsor, Conn. This generator is operated in multiple with a stationary storage battery in the station so arranged that when the current is not being delivered to the car batteries it is charging the stationary battery. This battery consists of 95 cells of 320 ampere-hours' capacity. This station is provided with two extra car batteries, the same as those described above, and which are charged in connection with the stationary battery. The arrangement is such that a steady load is provided for the engine and car batteries are charged without an undue expenditure of power. The battery shifting device provided for the Harvey station differs somewhat from that described for the main station, as the trays are mounted on trucks and are rolled by hand-power by means of a windlass under the elevating platform, which is raised and lowered by means of a stationary motor. The Harvey power station is a one-storey plain brick building, 30 feet × 70 feet, and is divided lengthways into two sections. In one is located the track and pit on which the car is run for battery shifting. The other section houses the power equipment.

In connection with the operation of the line, a funeral car is operated when chartered, which serves to carry the attendance at funerals for the different cemeteries that are located along the line. This car is named Virginia, and is handsomely upholstered; in fact, it is finished very much like the private cars on other lines. End doors through the front vestibule provide for loading and unloading the box containing the body.

The system is now operated under the management of E. R. Gilbert, with A. E. Davis as superintendent.

PHOTOTHERAPEUTICS; OR, THE LIGHT CURE.

By W. S. HEDLEY, M.D.

In the pages of the ELECTRICAL REVIEW and elsewhere the present writer has more than once drawn attention to the medical and biological effects of light. He has pointed out that some of these effects are demonstrable and accepted facts, and that light may now take rank among those other forms of radiant energy that have already rendered signal service to medicine. To those of us who have watched this development, and worked for its attainment, it is certainly satisfactory to have arrived at this point. Chief among the countries that have encouraged such researches is Denmark. An Institution founded three or four years ago by the benefactions of two individuals,* has now developed into a State-aided establishment, whose object it is to "carry on scientific researches concerning the action of light on the living organism, and chiefly with a view to its application in practical medicine." Its excellent work is already widely known throughout Europe, and our own country is amongst the first to profit by it; for, owing to the initiative of a benefactress, the apparatus used in this Institution is at this moment on its way to England, to be fully and fairly tried in a London hospital.

In the articles already referred to it was shown that the intensity or amplitude of the heat rays is increased as the light rays are added,† and the therapeutic effects of the luminous heat ray was in some measure dealt with. It was further explained that, ascending in the scale of refrangibility, when the blue, violet, and ultra-violet rays are reached, that is, when the calorific effect is least, and the chemical effect is greatest, a distinct and different set of physiological effects appear; and that one of the most striking of these is a destructive action upon certain micro-organisms; that the chemical rays are, in fact, bactericidal.

It is not proposed at present to deal with the general effects of light upon the organism. This has been already done in the above-named paper, and will be reverted to again. It is now intended to limit attention to the action of light when concentrated and localised upon a limited surface. It is this aspect of the question to which Dr. Finsen has contributed so much valuable work. In the first place, he points out that the effects of light as a purifying and disinfecting agent, a fact forcibly dwelt upon by Duclaux,‡ is due almost entirely to the chemical rays.§ The same is true of the bacillus of anthrax and the typhoid bacillus;‖ and d'Arsonval and Charrin,¶ experimenting with the pyocyanic bacillus have demonstrated that it is the chemical and not the calorific part of the spectrum that is the destructive agent. Charcot (1859) stated, and Widmark (1889) proved, that solar eczema (misnamed eczema caloricum) from which Alpine travellers suffer, is due to the most refrangible rays, and especially to the ultra-violet. With the thermometer marking a very low temperature, these effects occur, and they occur, perhaps most commonly, by reflection from the snow. In such cases it is, of course, the lower part of the nose and chin that is affected, the parts most directly struck by these reflected rays.

As a secondary result of the action of the light ray, there occur deposits of pigment, and this pigmentation is in its turn salutary—it appears to be Nature's way of preventing too deep a penetration of the chemical rays, and so protecting the animal against their injurious action. In such facts are also to be found (Unna. Finsen) an explanation of the colour of the negro, and the bronzing of the skin exposed to fierce and prolonged sunlight. Few of the readers of the ELECTRICAL REVIEW are unacquainted with the effect upon the skin and eyes of a strong electric light. A Russian physician, Maklakow,** having been asked to report upon these injurious effects as occuring in a large electric welding establishment near Moscow, submitted himself to experiment for the purpose of his inquiry. He describes his condition after having "assisted" at an electric welding operation with an arc "produced by 250 to 500 accumulators;" and gives a description which must come forcibly home to very many of us; it certainly does so to the present writer, who has at times had to do with those conducting photometric experiments without due precautions. Following the exposure a few hours, the first symptom was a pricking sensation in the skin, which gradually increased, and shortly afterwards there was coryza and lachrymation, that is to say, symptoms of a bad cold in the head, and profuse watering of the eyes. Later, he was unable to open his eyes, and he felt a burning sensation on the left side of his face and neck. After

* M. G. A. Hagemann and M. Vilt-Jörgensen.
† Tyndall's well-known experiment.
‡ "Semaine Médicale, 1885," quoted by Finsen.
§ *Proceedings of the Royal Society of London*, 1878.
‖ "Arch. de med. exper. et d'Anat. Path, 1891," quoted by Finsen.
¶ "Sem. medicale, 1894," quoted by Finsen.
** "Maklakow—Arch d' ophthalmol., 1889," quoted by Finsen.

a short sleep he awoke to find all the symptoms worse. In the evening there was redness and swelling of the face and that swollen condition of the ocular conjunctiva known as chemosis. He had a night of suffering, all the parts which had been exposed to the light having become inflamed; but it was remarked that the lining membrane of the eyelids was not swollen, although, as already stated, that covering the eyeball was so. On the following day the ocular pains diminished and a muco-purulent secretion in the eyes became established. The inflammation of the skin, however, continued to increase until night, when it somewhat abated. In a few days the skin desquamated in large flakes as if he had recently had scarlet fever; and there was some pigmentation of the skin. This, it is to be remembered, was an experimental case, and was allowed to run its course unchecked; it might have been materially alleviated by treatment. Such effects are undoubtedly due to the light, and not to the comparatively feeble heat rays. It may be remarked that in the case of a burn the pain is immediate; in such a case as that above related the pain only supervenes at the end of some hours.*

The injurious action of the chemical rays has been the means of introducing a new treatment of small pox, or, rather, a revival, based upon scientific grounds, of a treatment known and practised in that rather ill-defined period usually referred to as "the middle ages." This treatment seems to have survived even within the memory of persons living in the eighteenth century. It consisted in having the curtains and other surroundings of the patient's room exclusively red; in other words, in exclusion of the upper rays by means of filtration through red hangings. In recent years the action of light on the course of cases of small pox has been noticed by Picton (1832), by Black, Barlow, and Waters (1867 to 1871). In 1894 the subject was brought forward by Dr. Finsen, who proved that the injurious effect was due to the chemical rays, and that therefore red light was obviously the only kind admissible. This he elaborated into a system, and he states that it has been carried out by Dr. Lindholm (Norway), Swendsen Feilberg (Copenhagen), Strandgaard (Denmark), Benckert (Sweden), Moore (Dublin). The whole evidence leaves no doubt that the exclusion of the chemical rays by means of admitting only red light diminishes suppuration, prevents scarring, and shortens the fever. Such facts are of the deepest significance, but obviously lose some of their practical bearings in a country which trusts to prevention rather than cure.

In view of what has been proved of the microbicidal action of light, it is pointed out by Dr. Finsen in one of his instructive monographs that phototherapeutics must find a promising field of action in skin diseases of superficial kinds, caused by the presence of micro-organisms. Lupus is one of these.

It is, as everyone knows, a chronic disease of the skin, most frequent in the female sex, most commonly showing itself in childhood between the ages of 3 and 10, and, what is of interest in the present connection, it is caused by the tubercle bacillus. It is recorded that the "burning glass" has been empirically used in its treatment. Lehmann employed "a 12-ampere arc lamp," with the rays rendered parallel by a parabolic mirror. The subject has been energetically taken up by Dr. Finsen at the Institution already referred to, and with striking practical results. He shows that in order to get useful effects with light, it is necessary to concentrate it; and, therefore, in order to prevent burning of the tissues, to exclude calorific rays up to the yellow. It is quite certain, as already stated, that the bactericidal action lies in the most refrangible rays. The above objects are attained in more ways than one. If sunlight be used, a hollow plano-convex lens may be employed 20 to 40 cm. in diameter, filled with ammoniacal solution of sulphate of copper. Light from an electric source requires different treatment, the rays being divergent, not parallel, as in the case of the sun. The apparatus then consists of two telescoping cylinders, each of which contains two plano-convex lenses. The first pair are designed to make the divergent rays parallel and the second to converge the parallel rays; 10 litres of distilled water separate the latter pair. Beyond the fourth lens at the end of the apparatus comes the light-filter, consisting of a flattened glass cylinder containing the copper solution. More recently this apparatus has undergone modification, and rock crystal lenses are used, thus obviating the absorption of ultra-violet rays by the ordinary glass. It is not quite clear what amount of electrical energy is used for the arc lamps. It is given as 35 to 80 amperes, but the voltage of supply is not stated. The present writer for all phototherapeutic purposes uses from 15 to 50 amperes at 100 volts. It seems certain that to secure bactericidal action a concentration of chemical rays is required; and, further, Dr. Finsen is satisfied that the blood interferes to some extent with the penetration of light into the body, and he therefore uses pressure to exclude the blood as far as possible from the parts under treatment. He has designed a compress expressly for the face.

The procedure consists in subjecting a small surface at a time, say, 2 or 3 cm., to treatment. There is a daily exposure for two or three hours to the action of the rays, and treatment is continued for periods varying from "some days" to "many weeks," and even "three or four months." Dr. Finsen, who, as already stated, has elaborated this method, gives 59 cases, all improved but one, 23 being cured, and 30 remaining under treatment. Since then, he records 200 cases, 130 of which have been treated exclusively by the method in question.

Admitting the approved efficacy of the treatment by light in the case of lupus, it only remains to be asked, Is this method the quickest and the best? Even leaving out of sight other methods, and considering for the moment only the many successful results in lupus that have occurred by exposure to the X rays, it might be hazardous to venture a definite reply to this question. It may ultimately prove that what the ultra-violet rays do well, the ultra ultra-violet rays do better. But in the meantime, Phototherapeutics holds the field.

* This is in accordance with what has been observed of the action of those rays still higher in the scale, (?) the X and other rays that emanate from a focus tube, whose injurious effects sometimes take weeks to show themselves, and whose destructive action has been utilised under due regulation and control for the treatment of lupus, for epilation, and other purposes.

SOME NOTES ON SINGLE-PHASE MOTORS, WITH SPECIAL REFERENCE TO THE HEYLAND MOTORS.

By A. C. EBORALL.

The reference to the starting capabilities of single-phase motors in the Electrical Review of last week—namely, that up to the present it has been found impossible to build such motors to start against heavy loads—gives the writer an opportunity of bringing forward the capabilities in this direction of the Heyland single-phase motors, now being put on the English market by his firm. As far as concerns existing types of well-known motors, the statement in question is perfectly correct—not only will they not look at a load, but many of these motors require such heavy currents to start them *without* load that their use on lighting circuits (where alone single-phase motors are required) is discouraged in many places, and in others the demand for motive power is being met by laying down direct current power mains (for instance, Bristol, Clerkenwell, City of London, &c.)—a step which, though perfectly natural and the outcome of circumstances, cannot be regarded but with regret by all those who believe in the capabilities of the alternating current.

The single-phase motors patented by Mr. Heyland, which have been mostly built up to the present by the firm of Electricité and Hydraulique, Limited, of Charleroi, will not only start against full load, but they do this without complication or bother of any kind, and with moderate current consumptions. Moreover, if required, the starting torques can be made much greater than this, and a good single-phase traction motor is by no means such an impossibility as it appeared a year ago.

Before describing the fundamental principles and construction of these motors for heavy starting torques, it may not be out of place to discuss briefly, in general terms, what takes place in the commercial forms of single-phase motor during starting and running.

At the outset, it may be stated that all commercially successful single-phase motors belong to the induction type. That is to say, the stationary inducing system, or stator, whose windings are connected to the line wires, causes currents to circulate in the windings of the running part, or rotor, and these currents, in conjunction with the driving flux of the motor, produce the torque. A characteristic of all induction motors is, that the rotor windings are always closed upon themselves after once the motor is running at normal speed, though they are frequently arranged to be opened at starting for the purpose of inserting a starting resistance.

The easiest way of considering what goes on in a single-phase induction motor is to think of a two-phase motor. Let, for instance, a motor of the latter type be running from two-phase mains, and without load. Neglecting (as may quite well be done) the trifling power current required to make up the motor losses (under these circumstances practically only iron, ventilation and friction), the current read on an amperemeter in each phase is the "magnetising current" of that phase of the motor, that is, it is the wattless current required for driving the magnetic flux through the magnetic circuits of the motor; further, the speed is synchronous. Now let one phase be switched out. The motor will go on running as a single-phaser at practically the same speed, but the amperemeter in the remaining phase will read approximately twice the current that it did before—that is, the magnetising current in this phase has doubled. What has happened is briefly as follows: The magnetic flux originally provided by the switched-out phase is now replaced by a flux of approximately the same value and relative position furnished by a magnetising current in the rotor. Magnetising currents are called into being in the rotor induced by the magnetic flux of the phase still connected to the mains, and in quadrature with this flux with regard to time, and these currents are carried round nearly 90° in space by the practically synchronous rotation before reaching their maximum. Thus the cross-flux produced by them has very nearly the same effect as that formerly produced by the switched-out phase. The magnetising current in the rotor has, of course, to be balanced by a corresponding stator current, so that the amperemeter reads the magnetising amperes of phase 1, plus the magnetising amperes of the rotor transferred to the winding of phase 1. Hence the magnetising current in the latter approximately doubles.

With this perfect motor running at synchronous speed, it would be found that a voltmeter connected to the terminals of the switched-out phase would give a reading equal to the pressure on the mains from which phase 1 is running. This E.M.F. is that induced by the cross-magnetisation of the rotor currents, and is in quadrature with the impressed E.M.F. of phase 1, as explained above. In commercial motors the E.M.F. of phase 2, measured in this way, is not quite equal to that of phase 1. The magnitude of the difference between the two voltages is a measure of the quality of the design of the motor.

It has been said above that the motor continued to run as a single-phaser at practically the same speed. In reality the speed is a trifle less (the difference being too small to detect on a counter) owing to the fact that the rotor currents cause a slight slip, so that even a perfect single-phase motor (unlike the polyphase motor) cannot run at a synchronous speed at no load.

Of course, as the motor is loaded, the slip increases, that is, the speed departs more and more from synchronism. Under these circumstances, the induced rotor magnetising currents are carried round in space less than 90°, the cross-magnetisation produced by them is correspondingly reduced, and the rotary field of the motor is therefore not only less, but gets much less uniform, until finally the increasing load causes the motor to break out of step. When the rotor is stationary, the cross-magnetisation is reduced to zero; there remains now only the one flux of the phase connected to the mains (phase 1), and this flux cannot possibly produce a torque—that is, the motor cannot start—because its axis (that is, the axis of the exciting coils of phase 1) is in the same direction as that of the rotor flux produced by it.

To sum up then, we see that in order to enable a single-phase induction motor to start at all, an auxiliary starting field must be created that will do exactly the same thing as the rotor currents do at synchronous speed, or that a second phase would do. That is, with regard to space, a magnetic flux must be established in quadrature with the principal flux inducing the rotor currents, and with regard to time, this auxiliary flux must be in phase with the rotor currents, or what is the same thing, must be in quadrature with the

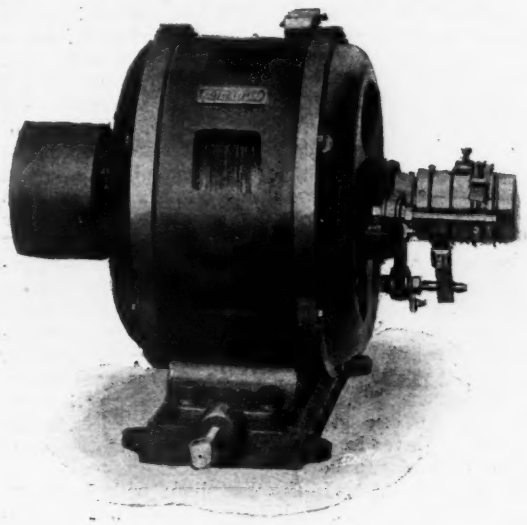


Fig. 1.

principal flux. Every single-phase motor must therefore not only have a starting device, but the amount of starting torque available will depend purely upon the effectiveness of this device with regard to fulfilling the conditions outlined above, and upon the value of the cross-flux produced by it.

Successful starting devices for single-phase induction motors have nearly all been arranged on the same general lines up to the present. The spaces between the running

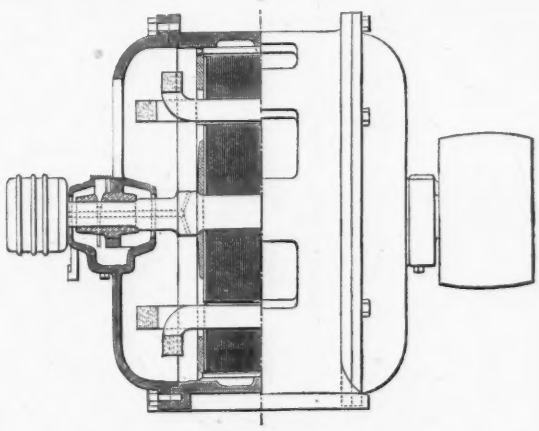


Fig. 2.

coils* on the stator are filled up with starting coils, and the two sets of coils are furnished at starting with distinct currents differing in phase from one another by means of an external phase-splitting device, assisted by suitable proportioning of the starting winding. The usual arrangement at starting is to switch the running coils on to the line either with or without a non-inductive resistance, and to put the starting coils in parallel with them through either a choking coil, condenser, or non-inductive resistance, depending upon the relative proportioning and arrangement of the two windings, the actual con-

* It is worse than useless to fill up all the slots of the stator with the running coils—that is, with the winding that is always in circuit, and which furnishes the principal flux of the motor. Two-thirds of the slots are usually taken up by the running coils, and the remaining one-third by the starting coils. Four to eight slots per pole per phase are generally allowed for the former.

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nections employed, and the particular maker's ideas. But none of these devices have proved particularly successful, especially when used with high frequency motors. The starting torque is always insignificant, frequently barely sufficient to get the motor under way with the load of the belt and loose pulley, while the starting currents are invariably excessive—for instance, it has been considered good if a motor can run up to full speed without load with a current consumption equal to 1½ times the full load current! These indifferent results are due to the fact that the phase differences of the two fields produced by all the above-mentioned devices are quite small, generally considerably under 30°, and moreover, the field produced by the starting coils does not reach a high value. Some makers have tried the effect of "staggering" the starting coils—that is, instead of winding these coils midway between the running coils, they have been displaced by the width of one or more teeth, thus giving a space displacement of less than 90°, in order to try and make up for the phase displacement of the current in the starting coils being so far from the correct amount. But no appreciable gain has resulted from this; moreover, useful winding space is lost.

Phase-splitting devices employing choking coils or condensers in the line circuits are in any case objectionable. The use of the former causes a low power factor at starting, large wattless currents, and consequently heavy C^2R losses. The employment of condensers is open to the objection that they frequently give a lot of trouble owing to the unmechanical nature of their construction.

The Heyland motors differ but little with regard to general design from other well designed motors of the induction type, but the principles underlying the action of the starting device, as also the method of applying them, are quite new in the alternate current motor field, while the results arrived at with these motors are far beyond anything hitherto obtainable.

The appearance and general design of the motors can be seen from figs. 1 and 2. The motor for sizes up to 100 H.P. is built either ironclad (as shown here) or else totally enclosed; a more open construction is used for larger outputs. The winding of the stator is shown diagrammatically in fig. 3, which illustrates that of a four-pole motor.

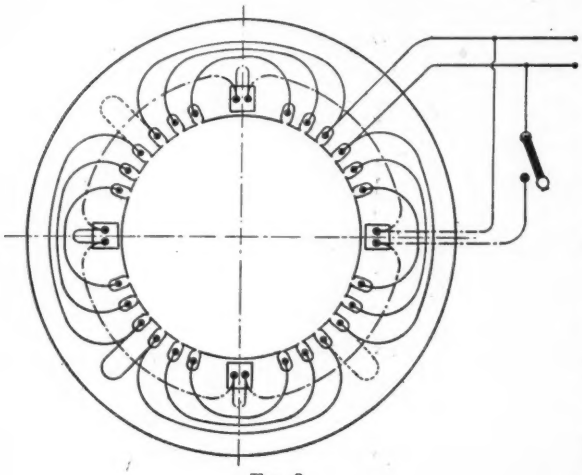


Fig. 3.

The running coils are wound drum fashion in the small half-closed slots, there being, of course, more than one wire per slot; these slots are insulated with micanite tubes. The starting coils are located in the large square holes, and it is the magnetic flux produced by these coils which produces the starting torque. The stator core discs are not built up in the motor case in the usual way, but each stator is finished complete with its winding and then put into the motor case. The depth of magnetic material in the stator can thus be conveniently varied within limits to correspond to small departures from standard outputs, &c. It will be noticed (fig. 2) that there is a considerable air space between the case and the stator core; this is arranged for in order to reduce magnetic leakage through the case, and, moreover, increased cooling facilities result.

The number of poles formed by the running coils, and the turns and section of the winding per pole are calculated out in the usual way; the number of turns of the starting winding is, however, always kept small, for the reason given later on.

The rotor is an ordinary three-phase rotor, that is, it has some form of barrel winding carried out in slots, and

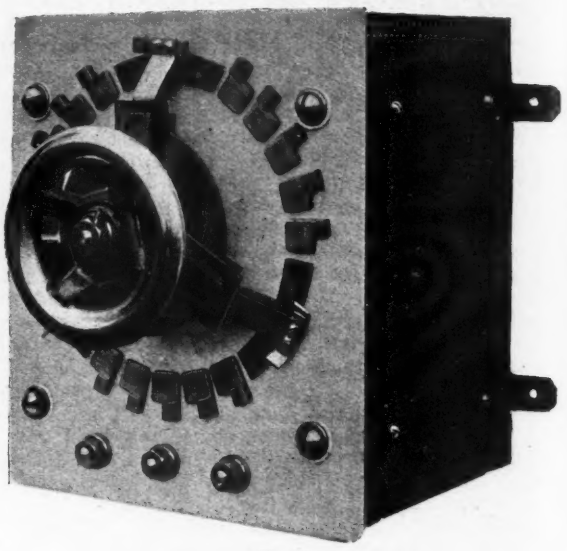


Fig. 4.

star-connected in three circuits. The ends of the three circuits are taken to three overhung slip-rings on the shaft, which are connected by means of suitable brushes to the star-connected non-inductive starting resistance shown in fig. 4. The insertion of this resistance at starting has two good effects, just as with polyphase motors—firstly, the starting current is limited in amount; and secondly, it is brought more into phase, thus improving the power-factor at starting, and also the values of current and watt consumption per unit of torque.

The starting of the motor is effected as follows:—All the rotor resistance being in, the single-pole switch (fig. 3) is first closed, and then the motor switch proper. The motor will immediately start up with great power, and the rotor resistance has now to be cut out, step by step, until the slip rings are short-circuited. The auxiliary switch can then be opened, when the motor will be running under normal conditions at full speed. For elevator and similar work, the single-pole switch and starting resistance are operated together by means of a suitable link coupling.

The displacement of phase obtained with the above simple starting device (which does not effect the running winding in any way, nor the general proportions of the motor) is very great, and can be made to approximate very closely to the ideal conditions. It is, of course, due to the relative unsymmetrical relations of the two windings with regard to the rotor, causing great magnetic displacement. The field produced by the starting coils can be made as great as desired, and the torque of the motor is limited only by the fact that after a certain point over-saturation of the iron comes in. For the standard motors with normal starting torques, the adjustment of this auxiliary field is made by adjusting the number of turns. As a definite back E.M.F. has to be produced in the starting coils, given by the supply E.M.F., it follows that the strength of the starting field is inversely proportional to the number of starting turns, and to nothing else. Hence, to get powerful fields, the turns must be small, and consequently in these motors, as stated above, the starting winding located in the square holes consists of but few turns, and the starting torque for different purposes is adjusted by the proportions of this winding.

The great differences existing between the Heyland starting device, and those which have preceded it will now readily be seen to be as follows:—

In all other phase-splitting devices, the fundamental idea is that a rotary field is to be generated, in order to enable

the motor to start, and as pulsations of a rotary field mean loss, all the arrangements in use have been designed with a view to reducing these pulsations to a minimum—that is, a rotary field of constant strength has been aimed at. In accordance with this, it would be a great mistake to make the field of the one set of coils greater than that of the

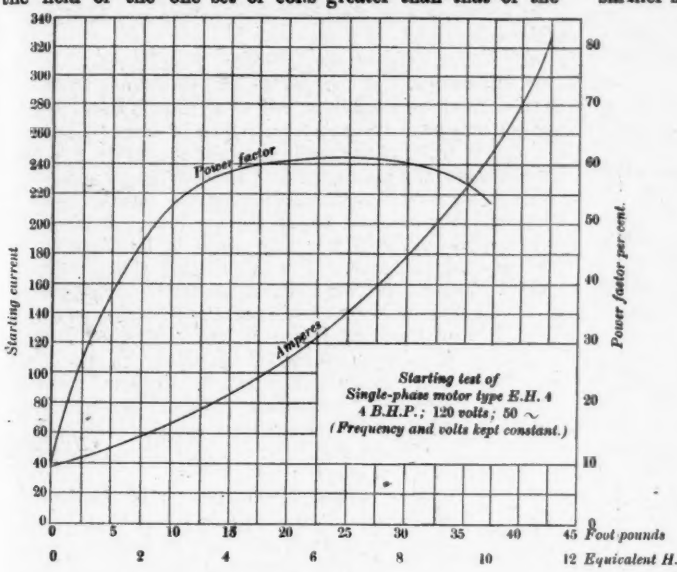


Fig. 5.

other. Moreover, in all these devices, in order to get a large phase difference, it has invariably been the practice to make the starting winding of large self-induction, as phase difference increases with the self-induction. But with increased self-induction the field producing the torque falls, so that the latter must always be small.

Now, Mr. Heyland's views are practically opposed to this. He does not trouble about the rotary field at all, but designs the starting coils to give simply an alternating field of large phase difference at right angles to the running coils, this

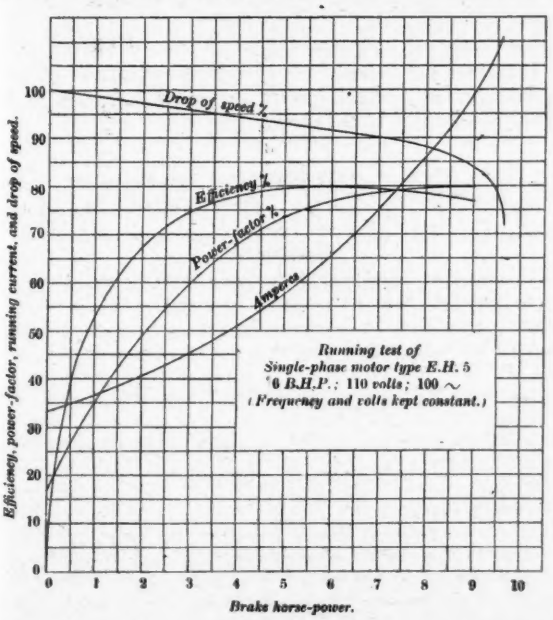


Fig. 6.

field having as great a value as possible, and always being larger than the field of the running coils, or coils carrying a current of small phase difference. The large phase difference of the magnetic flux of the starting coils is produced, not by designing the latter to have great self-induction, (which would have the effect of diminishing the flux required to produce the torque), but by displacing the flux magnetically in the manner shown. At the same time, this cross-flux has a high value, because the self-induction of the circuit producing it is quite small, owing to the small number of turns. To sum up, the design of the Heyland motors, with regard to the starting device, is along lines directly opposed to generally accepted practice, insomuch as the starting coils, causing the flux of great phase difference, have a much smaller self-induction than that of the running coils; moreover, the auxiliary flux of the starting coils is purposely arranged to be much greater than the flux of the running coils.

The actual performance of these motors, both when starting and running, is well shown by the typical test curves given (figs. 5 and 6). Fig. 5 shows the relation between torque and starting current and starting power factor for a 4-H.P. motor designed to give a specially large torque. The full load current of the motor is about 43 amperes at 120 volts, 50 cycles. From the curve of current and torque, it will be seen that the motor starts with a torque equal to that at full load with a current consumption of 84 amperes, or about double that at full load. At the same time, the starting power factor attains the remarkably high figure of 59 per cent. The maximum torque the motor will give at 120 volts is about three times that at full load. The slip of this motor at full load was 6 per cent., efficiency 74 per cent., and power factor 77 per cent.

Fig. 6 gives an idea of the performance of these motors when running. The motor in question (designed to run on a lighting circuit in the North of England) is nominally of 6 B.H.P., 110 volts, 100 cycles. From the curves it will be seen that the full load quantities are as follows: — Current, 66 amperes; efficiency, 80 per cent.; power-factor, 77 per cent.; and slip, 8½ per cent. The maximum power factor is 80 per cent., and the maximum load without falling out of step about 9 B.H.P. No special starting torque was asked for with this motor, but it was specified that the starting current should not exceed 100 amperes. At this current consumption the motor started with a torque equivalent to 3 H.P., thus half the full load torque with one and a half times the full load current.

From the commercial aspect it is always necessary to look to the weight of a machine when considering its efficiency, &c. The tabulation given below for the standard sizes of Heyland motors supplied by Messrs. Witting Bros., Limited, will show that they are not by any means unduly heavy for their output:—

Standard Heyland Motors.

For 50 cycles and 100 to 800 volts.

B.H.P.	Revs. per minute.	Power factor. Per cent.	Efficiency. Per cent.	Weight. Lbs.	B.H.P.	Revs. per minute.	Power factor. Per cent	Efficiency. Per cent.	Weight. Lbs.
⅛	1,500	55	50	66	15	1,000	80	83	1,100
¼	1,500	60	60	99	20	1,000	82	85	1,100
½	1,500	65	65	143	30	1,000	83	87	2,000
1	1,500	70	70	154	40	750	85	89	2,640
3	1,500	73	75	308	60	750	85	90	3,500
5	1,500	75	80	440	80	750	85	90	4,400
10	1,000	80	82	660	100	750	85	91	5,000

These motors, whose full load efficiency and power factor are given above, are designed on the following lines:—

1. Temperature rise after eight hours at full load will not exceed 40° C.

2. Drop of speed varies from 10 per cent. in the smallest size to 3 per cent. in the largest motor.

3. All motors have a loading limit of 1½ times the full load.

4. The motors are designed either to start up with a torque equal to full load, the current consumption being twice the full load current, or else to start with a torque equal to two-thirds of that at full load, the current being 1½ times the full load current.

Note.—In the writer's remarks on the starting of single-phase induction motors, all methods of bringing the motor

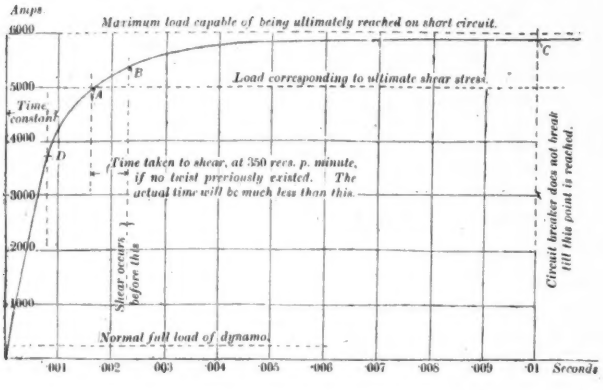
up to speed involving the use of mechanical means, or of a commutator, were not considered, on account of such methods being unpractical, expensive, and hardly ever used in practice.—A. C. E.

CORRESPONDENCE.

Stresses in Engine Shafts.

I do not think anyone will question your contributor's statement that the capacity of a shaft to resist a suddenly applied twisting moment is one-half of that which it would be were the twisting moment gradually applied. In other words, the factor of safety must be doubled where the shaft has to resist suddenly applied twisting moments.

So long as we understand one another there is no point in haggling over definitions; my object is to get at the truth of the matter, and not to attack any statements your contributor may have made.



But perhaps I may be allowed to recapitulate, in the light of his subsequent correspondence, what I understand was really meant by the closing paragraph in your issue of September 1st (page 376):—

1. A suddenly applied stress is, in its effect on the shaft, equal to double that stress gradually applied.

2. The crankshaft on the engine side of fly-wheel has already been designed on this assumption; therefore, if we further assumed that the armature current never exceeded the "ordinary," we could put in a shaft on the dynamo side of the fly-wheel of the same diameter as on the other side. (To be logical, it seems to me that "ordinary" should be defined, *not* by the rated output of the engine, but by the maximum possible thrust on the crank pin at any period of the revolution; but let this stand.)

3. Your contributor says, in the article above referred to, "allow 50 per cent. excess stress," and he calculates the shaft on this basis. I submit that this is not strong enough, and that if the design he was then considering be adhered to (*i.e.*, the fly-wheel and armature separate) it should be made several fold stronger.

In an article in your issue of the 22nd inst., headed "Engines for Electric Traction," you mention incidentally that I seem to have come to the conclusion, but appear disinclined to put it down plainly, that the cut-outs will *not* act in time to save the great rush of current that tends to occur when there is a short circuit in the line. This is quite true; I had doubts whether the time lag of the generator was small enough, and the time lag of the cut-out large enough, to permit such a rush of current.

I have, however, now made an attempt to find the order of magnitude of the time lag in the generators of which the shafts were sheared off in the instance I gave, and as this, if correct, goes to show clearly that in some cases, if not in all, the dangerous rush of current is practically all over before the circuit-breaker acts, I have embodied the results in a diagram which I now send you to publish with this letter if you think it of sufficient general interest.

This diagram is based on the following assumptions:—

1. That the flux through the field magnets is not materially altered during a short circuit, due to the steadying effect of the shunt coils, &c.

2. That the flux through the armature core is also not materially altered; so that

3. We may regard the armature winding (considering the enormous rush of current which there tends to be on short circuit) as sensibly a coil of wire embedded in air; and the only path available for the lines of force (of its own making) as being in the confined space between the field and the armature, and the return path between the core discs.

We may then accept the solution for the establishment of a current in a solenoid under the application of a steady impressed E.M.F. as of the form given by Dr. Fleming on page 103 of his book, "The Alternating Current Transformer," Vol. I. Having calculated out the time-constant of the armature on the above assumptions, I draw a curve of the shape indicated by Dr. Fleming through a point (D) obtained by setting off the time-constant along the axis of abscissæ, the corresponding proportion (0·63) of the maximum short-circuit current along the axis of ordinates.

On the particular machine in question this occurs at about 3,700 amperes.

Assume that 5,000 amperes is the load at which the ultimate shear stress of the shaft would be reached, the ordinary working load of the shaft being only 250 amperes, a factor of safety of 20 being thus allowed (assuming load proportional to current, for the sake of simplicity).

We then see that the shaft would shear soon after the point (A) on the curve was reached; an interval of about ·0016 second from the commencement of the short circuit.

The automatic cut-out does not go till after the point (C) is reached, taking Mr. Dawson's statement of $\frac{1}{100}$th second for an "I.T.E." cut-out in preference to my own estimate of ·024 second.

It is evident that my calculation for the time-constant might be 1,000 per cent. wrong, and *yet* the circuit-breaker would hardly protect the generator.

If there is any external resistance (such as feeder or track) other than the dynamo, the time constant is *reduced*, and the circuit-breaker is still less a protection.

A. M. Taylor.

[We hope to show some diagrams which will throw some light on the question in an early issue.—Eds. Elec. Rev.]

Fly-wheels.

The ideal fly-wheel would probably vary its speed much more rapidly than the engine. A fly-wheel which would give up nearly all its energy when the engine slowed down, say, 10 per cent., would probably do its work very well and not be likely to do damage. It could also be made much lighter than the ordinary fly-wheel. These results could be obtained by running the fly-wheel by means of belting running on coned pulleys; the position on the coned pulleys being fixed by a governor. Or the fly-wheel might be made with heavy masses of metal arranged to slide on the arms. Normally these masses of metal would be constrained towards the centre by means of springs, but when the speed of the fly-wheel increased they would fly outwards and thus absorb energy owing to the increased velocity; when the speed of the fly-wheel decreased these masses would come towards the centre and so give up their energy.

Electrically the fly-wheel might be driven by a differentially wound motor in parallel with the main generator, the series coil being in opposition to the shunt. When the voltage of the main generator increased the series coil would weaken the field magnets of the motor and thus cause it to increase its speed. If the voltage of the main generator were to decrease then, owing to reversal of current, the series coils on the fly-wheel motor would tend to increase the strength of the magnets which would thus cause the motor to act as a generator and deliver energy to the mains.

Most likely, however, the best solution of the difficulty will be to use accumulators as suggested in a recent number of *Cassier's Magazine*.

Charles Turnbull.

North Shields.

The Lancashire Electric Power Company as a Standby.

During the past few days the users of electric power in Manchester have had an experience to teach them the necessity of an independent source of supply in case of emergency.

It will be fresh in the minds of many people that a meeting of representatives of several municipal authorities was held at Manchester in January last to organise opposition to the above company's Bill; they did not wish anyone to supply electricity beyond their own municipal source of supply.

In a letter to several newspapers about that time, I contended that an independent source of supply was needed, and quote the following:—"This source of electric power may also be used as a standby, to be used in case of sudden emergency, or failure of the municipal source of supply."

Those who were opposed to the above scheme will perhaps see how convenient it would have been to have had some outside source of power as a standby to help the municipal source of supply out of a difficulty. The kind of accident that happened at Manchester last week is liable to occur in the best designed generating plant, with the same or even worse results. With a breakdown of gas generating plant it is possible to plod along for a time, but in the breakdown of an electric generating plant the stoppage is sudden, the only remedy being a large plant of storage batteries; so, even if a municipal authority has spent thousands of pounds in plant, it is not infallible, and I think those who opposed the above Bill will now see that there is something in having an independent source of electric power in their midst.

Thos. Winstanley.

Manchester, *September 26th*, 1899.

STANDARDS OF MEASUREMENT.*

The last report of this committee related to the redetermination of the electro-chemical equivalent of silver by Drs. Patterson and Guthe by means of a specially constructed electro-dynamometer. The result was 0·0011192 gramme per ampere per second. During the past year the same electro-dynamometer has been employed in making an absolute determination of the electromotive force of the Clark standard cell.

Two cells were made by the secretary of this committee in accordance with the specification which has been legalised in the United States. The two were made at an interval of a year, but at the same temperature they do not differ more than one part in 10,000.

The method adopted in measuring their electromotive force was to compare the electromotive force of the two in series with the fall of potential over the resistance of a coil of manganin wire immersed in paraffin oil, when the current through it balanced the torque of the phosphor-bronze wire of the electro-dynamometer when twisted through one complete turn. The comparison was made by applying the Poggendorff method to the cells and to the potential difference between the terminals of the manganin coil in succession. Since the resistance of the manganin coil is involved in the measurement, it must be known with accuracy; for this purpose two standard one-ohm coils were ordered from Wolf, of Berlin, with certificate from the Reichsanstalt. These coils arrived in June.

Three independent comparisons were made with the cells at 15° C. The temperature was measured by immersing the cells in a bath of petroleum, and taking the temperature by means of a thermometer made by Haak, of Jena, reading to fifths and calibrated at the Reichsanstalt. Its number is 11,021, and at 15° it reads 0·05° too low.

The result of the three measurements is 1·4333 volts at 15°. Glazebrook and Skinner, by the silver voltameter method, and assuming 0·001118 as the electro-chemical equivalent of silver, obtained 1·4342. Kahle found, by means of a Helmholtz electro-dynamometer, 1·4338. His value of the silver equivalent is 0·0011182. But Kahle says that silver nitrate neutralised by silver oxide gives a larger value for the electro-chemical equivalent by five parts in 10,000. Neither Kahle nor Glazebrook appears to have employed the neutralised silver nitrate solution. The value 0·0011192 was obtained by the use of the neutralised solution. Hence the silver equivalent for the solution used by Glazebrook equals 0·0011187. Assuming this value instead of 0·001118, Glazebrook's result is reduced from 1·4342 to 1·4332. This is practically identical with the value now reported by the secretary of this committee and Dr. Guthe, which is 1·4333.—Henry S. Carhart, *Secretary of Committee.*

* Report of the Committee on "Standards of Measurement," from *Proceedings American Association for the Advancement of Science.*

THAT BLESSED WORD "ELECTRICITY."

One of the greatest hindrances to the advancement of electrical knowledge in the popular sense is the facility with which unscrupulous individuals are enabled to trade upon the credulity of the uninitiated, by the cloak of mystery which shrouds all things electrical. One need only lay claim to the invention of some new and wonderful process or machine, making free use of the word electricity, but affording no actual details of the means employed, in order to become a hero in the eyes of the daily Press—and, therefore, of the public. This condition of things, has, unfortunately, been aggravated by the marvellous character of the genuine discoveries which have been made in recent years. When a man has been convinced by actual trial that he can see through substances which he has been accustomed to regard as opaque, and hear the voice of his friend beyond the sea, he is quite prepared to be told that his eyes are by no means indispensable to the faculty of seeing, or his ears to that of hearing, provided, of course, that the word "electricity" is employed.

Quite recently the non-technical papers have been deeply interested in an alleged discovery by a Mr. Stiens, who asserts that he can "make the blind to see." "My apparatus will," he says, "as in the camera, focus the rays of light from the object to the brain, and sight is given." . . . (We quote from a well-known morning paper.) The apparatus, of which absolutely no particulars are given, is said to be portable, and to be available for the ordinary practical purposes of life. A representative of the Press, who interviewed Mr. Stiens, was deeply impressed by a practical demonstration, but could obtain no explanation of the system. Mr. Stiens also claimed to give hearing to the deaf, even if the auditory nerve were deranged! Time will show how far these claims are justified.

Turning to another field of—*invention*, we learn that an American chemist and electrician has "solved the problem of robbing the air and its moisture of its power and storing it in a battery in the form of electrical energy."

To convert power into energy is a sufficiently colossal triumph; this, however, it is true, is frequently accomplished on paper by the non-technical press and by the engineer who ought to know better. "The cells collect the electrical energy directly from the atmosphere and give it up as power (*sic*) immediately." The use of steam is to be abandoned, &c., &c. As usual, the long-suffering and much misquoted Edison is dragged in to express an opinion in superlatives. We need not wait for time to deliver a verdict on this discovery. We have been used to hearing that electricity is in its infancy; truly, it is the electrical knowledge of the editors of non-technical, and of some technical, journals that is infantile.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Sept. 27th, 1898.		Week ending Sept. 26th, 1899.	
Adelaide	Value £890	Antwerp. Elec. fuse	Value £246
Amsterdam	222	Barcelona. Teleg. mat.	100
Bombay	50	Bombay	21
Calcutta	98	Buenos Ayres. Teleg. mat.	295
Cape Town	138	Calcutta	982
Colombo	58	" Teleg. wire	112
Copenhagen	57	Cape Town	891
Durban	412	Channel Islands	8
Fremantle	53	Christiania. Teleg. wire	196
Hamburg	14	Colombo	208
Launceston	13	Durban	546
Madras	13	East London	78
Malta	24	Ghent	24
Melbourne	432	Gibraltar	12
Nagasaki	189	Gothenburg. Teleg. wire	29
Perth	306	Hong Kong	82
Port Elizabeth	44	Jamaica. Teleg. wire	78
Shanghai. Teleg. mat.	23	Launceston	117
Singapore. Teleph. mat.	108	Madeira	245
Stockholm. Teleg. wire	98	Madras	243
Sydney. Teleg. cable	210	Malta	37
Tientsin	108	Melbourne	120
Wellington	50	" Teleg. cable	514
		Montreal	25
		Ostend	76
		Penang	145
		Perth	73
		Port Elizabeth	28
		" Elec. cable	150
		Rotterdam. Teleg. mat.	100
		St. Petersburg	45
		Stockholm. Teleg. wire	100
		Sydney	948
		" Teleg. cable	1,131
		" Teleg. mat.	197
Total	£5,618	Total	£8,047

Foreign Goods Transhipped.

Barbados. Teleph. mat.	Value £106

Ayr.—A new pipe organ, worked by electric motor, is to be erected at Cathcart Street Presbyterian Church.

Bankruptcy Proceedings.—A receiving order has been made in the case of F. G. W. Adams (of Downie & Adams, electrical engineers), 24, Newman Street, Oxford Street, W., on the petition of a creditor. The first meeting of creditors and the public examination are arranged for October 3rd and November 8th, respectively, at Bankruptcy Buildings, Carey Street, W.C.

A sitting for public examination was held under the bankruptcy of L. Lawrence, (trading as Lawrence and Butcher), electrical engineer, 5, Stafford Street, Old Bond Street, before Mr. Registrar Giffard at the London Bankruptcy Court on Tuesday last week, the statement of affairs showing liabilities £334 and assets £5. The debtor began business, without capital, at Stafford Street about four years ago. Six months later he was joined by Mr. Butcher, who found £200 for the business, and the partnership continued for 18 months, being dissolved in June, 1897, by mutual consent. He continued to trade until Christmas last as Lawrence & Butcher and then closed the shop and took offices at the same address, where he remained until June last, when the landlord distrained for rent. He had since been without occupation and dependent on relatives. About the beginning of December last negotiations were opened with a view to the formation of a limited company to take over his business. The capital of the company was to be £2,000, and he was to have received 1,000 fully paid up £1 shares, and his services were to be retained as managing director at a salary of £100 per annum. The company was duly registered on February 27th last as Lawrence and Butcher, Limited, but nothing definite came of the negotiations. He attributed his failure to bad debts, and to losses on contracts owing to ill health. The examination was concluded.

Liquidations.—The Western Counties Electric Light and Power Company, Limited, is winding up voluntarily for the purposes of reconstruction, Mr. H. Dyer, of Bank Chambers, Corn Street, Bristol, being appointed liquidator. He is authorised to register a new company (the Keynsham Electric Light and Power Company), and to sell and transfer all the assets, &c., of the old company to the new company under terms and conditions arranged in an agreement between the Western Company and G. J. T. J. Parfitt.

We are informed that the Phœbus Solder and Electric Soldering Fluid Company is in liquidation for the purpose of reconstruction.

"Beacon" Resistance Wire and Armature Binding Wire.—Messrs. W. N. Brunton & Son, Musselburgh, send us two samples of "Beacon" wire created to withstand damp and atmospheric influences. The first sample is of the wire as manufactured and supplied; the second is cut from a coil which has been exposed to weather for about seven months, close to their galvanising sheds where acid fumes and steam are the chief characteristics. This wire has lost almost nothing in diameter and is not by any means rusted, the only change apparent being a blackening of the surface. The firm is also manufacturing special tool steels of high quality and an armature binding wire to take the place of phosphor bronze or piano wire. They have already supplied a large quantity. It is easily soldered and has a high tensile strain. Our representative was recently shown through the works which are completely equipped for turning out the various specialties of the firm, one of which is a shaped wire, in various sections, for fine tools, and another a covered resistance wire for electrical instruments. All the work is carried on under the direct supervision of members of the firm, which is to a large extent a guarantee of thoroughness.

Books Received.—"Problems in Machine Design," by Charles H. Innes, M.A. Manchester: The Technical Publishing Company, Limited. 4s. 6d.

"Notes on the Construction of Cranes and Lifting Machinery," by Edward C. R. Marks, M.I.M.E. Manchester: The Technical Publishing Company, Limited. 3s. 6d.

"Terminal Index for Use with McNeill's Mining and General Telegraphic Code." London: Whitehead, Morris & Co., Limited. 7s. 6d.

"Electricity Simplified."—A popular treatise, by A. T. Stewart. Edinburgh: Bishop & Sons.

"Penrose's Pictorial Annual."—The Process year-book for 1899. London: Penrose & Co.

A British Ice Association.—The editor of *Cold Storage* writes to us as follows:—"In view of the increasing importance of the refrigerating, cold storage and ice industries, it has been resolved to form a British Ice Association to promote these trades, to benefit and safeguard the interests of members in all matters affecting their business welfare, to enable members to meet periodically and to correspond, to facilitate the interchange of ideas respecting improvements in the means of producing cold, and the applications thereof, and to publish and otherwise communicate information on such subjects. It is suggested that all British subjects having a real connection with the refrigerating industry, with the keeping of cold stores for the use of the public, and with the ice trade, should be eligible as members, and that provision should be made for associate and honorary members. The scheme has already gained strong support, but as some of your readers may not have heard of the proposal, I shall be obliged if you will permit me, through the columns of the Electrical Review, to invite any such to communicate with me at 19, Ludgate Hill, E.C.

British Fire Prevention Committee.—The arrangements for the Winter Session will again include a comprehensive series of fire tests, to which it has also been decided to invite distinguished guests from abroad, the almost international interest accorded to the work having led to a number of applications from foreign officials, architects and engineers to attend the experiments. In October there will be further investigations with doors of various materials, with floors, patented partitions, and non-inflammable materials. The operations of the testing station will then probably be extended to experiments with automatic fire alarms. Mr. G. E. Monckton has again taken up the duties of secretary, which ill-health compelled him to relinquish last February.

Catalogues.—The Edison & Swan United Electric Light Company has issued a new wire catalogue (Section V.), in which are included wires, cables, wiremen's tools and sundries, arc lamp carbons, dynamo brushes, jointing materials, casing and capping, wood blocks and sundries. In the opening pages there are some short notes on joint making which should be of service to the wireman, also on the selection of cables, the Ediswan "fall of potential" table, tables of sizes, weights, resistances and working currents of copper wires, a table of electric light wires and cables of various descriptions of insulation, &c., flexible wires and cords for incandescent lighting. Other tables are included of bell and telephone wires, telegraph and telephone trunk and aerial cables, soft binding wires, instrument wires, platinoid wires for instruments, resistances, &c. The list is as usual nicely arranged, and there are a good many illustrations of the various sundries described in the list.

From the Ward-Leonard Electric Company, of Bronxville, U.S.A., a list (997) comes to hand illustrating the principal types of rheostats and circuit breakers manufactured by them.

The British Electric Transformer Manufacturing Co., Limited, of Woodfield Road, W., have issued a well set out booklet of about 50 pages devoted to general notes on transformers, and especially to a description of the Berry type of transformer made by them. The relation of transformers to continuous current distribution, their application in tramway working, temperature rise, radiating power, ventilation, mechanical strength, ageing of iron, copper losses, overload, and various other matters, are commented upon, and a number of illustrations of Berry transformers are given, including one showing a bank of 250-KW. 11,000-volt transformers, built for the Metropolitan Electric Supply Company, and a 100 KW. three-phase transformer. There are several views of the company's works showing the several departments. Altogether the publication, which is well printed and illustrated, possesses considerable interest.

Messrs. Julius Harvey & Co., of Queen Victoria Street, E.C., send us a copy of their new catalogue of steam, oil, and electric motor vehicles. In each of the sections specimen motor cars of various kinds are shown, but the electrical section comes off badly with only one item, and that an expensive electrical victoria. We understand that Messrs. Harvey lay claim to being pioneers in this growing industry.

Correction.—In a recent issue we stated that Messrs. Philips & Co., of Eindhoven, Holland, have a daily output of incandescent electric lamps amounting to 15,000 C.P. The daily output is, however, 15,000 lamps, not C.P.

The D.P. Battery Company.—We are informed that the successful candidate for the appointment of works' manager at the company's new works, which are now in full operation, is Mr. W. S. Worthington, late of the Epstein Accumulator Company.

Educational Notices.—We have received from the Electrical Engineer Institute of Correspondence Instruction, New York, a catalogue of electrical engineering, mechanical engineering and other courses. The booklet is made the more interesting by photographs of about 20 past and present leaders in electrical science. The courses taught include all branches of electrical engineering, including electric lighting, electric railways, electric mining, telephony, telegraphy, mechanical engineering, mechanical drawing, &c. Mr. Joseph Wetzler, M.E., E.E., is the President of the Institute, and Mr. T. C. Martin, editor of the *Electrical World and Engineer*, is vice-president. The catalogue will be sent free on application to the main office, 120-122, Liberty Street, New York.

The Birkbeck Literary and Scientific Institution has just issued its calendar for the 1899—1900 session, giving syllabus of classes, schemes of work, results of examinations, &c. Illustrations are given of some of the departments, including the electrical and chemical rooms.

For the Northampton Institute electrical engineering department an instructor in electrical engineering design and calculations is wanted for evenings, also a junior technical assistant for full time. See "Official Notices" this week.

The Council of the North of England Institute of Mining and Mechanical Engineers, in collaboration with the Council of the Durham College of Science, have arranged a course of lectures for colliery engineers, enginewrights, apprentice mechanics, and others, to be delivered at the Durham College of Science, Newcastle-upon-Tyne. The course will extend over three winter sessions. The delivery of the course of lectures will commence on September 30th, 1899. Particulars on application to Mr. F. H. Pruen, Secretary, Durham College of Science, Newcastle-upon-Tyne, or Mr. M. Walton Brown, Secretary, North of England Institute of Mining and Mechanical Engineers, Neville Hall, Newcastle-upon-Tyne.

Enclosed Arcs for Illumination Purposes.—The British Thomson-Houston Company has issued another of its beautifully illustrated pamphlets. The present one is entitled "Artificial Illumination by Means of Enclosed Electric Arc Lamps." The good points in enclosed arcs for shop window illumination, interior works, and mill lighting, are emphasised, the advantages of an efficient lighting system, both from an advertisement point of view and on account of increased volume and efficiency of work executed, being stated. Considerable weight is given to these words by a number of photographic reproductions of shop showrooms and works interiors lighted by enclosed arcs, the benefits of electric lighting being still more distinctly shown in a view of a furniture

establishment lighted by incandescent gas, the effect being such as to convey the impression that the mantles were quite ready to shuffle off this mortal coil.

Fire.—The Incandescent Electric Lamp Company notify that the fire which occurred in the Robertson Electric Lamp Works was rapidly overcome owing to the promptness of the firm's own fire brigade. No damage was done, and the supply of lamps will not be interfered with in any way.

For Sale.—From our advertisement pages particulars may be obtained of a proposed sale of goodwill, plant and machinery, stock-in-trade, patent rights, and book debts in the business of Sydney F. Walker (S. F. Walker & Co., Severn Road, Cardiff). The sale is to be conducted by Messrs. W. C. Clarke & Dovey, of Cardiff.

Liner Lighting.—Messrs. W. C. Martin & Co., electrical engineers, Glasgow, have secured the contract to fit the large Cunard Liner *Ivernia*, launched at Wallsend on Thursday last week, with electrical plant for lighting and power. The electric lighting of the vessel is to be on a very extensive scale, the plant consisting of two compound engines coupled direct to two dynamos, each set capable of supplying power to light 1,500 8-C.P. lamps. A powerful search light giving 20,000 C.P., is to be fitted at the bow of the steamer for navigating purposes, and a thorough system of heating and ventilating all the rooms, machinery and cargo spaces will be installed. Ten 3-B.H.P. electric motors and 10 30-inch fans, direct driven, will be fitted. Five of the fans are to drive cold air through Stewart's patent thermo-tanks heated by steam, where the air will be heated to a certain temperature, and then carried into each room by ventilating trunks. The other five fans will exhaust the foul air from the holds at the rate of 12,000 cubic feet per minute. Electric motors will also be used for driving the hair brushes in the barber's shop, and for other purposes throughout the steamer.

New Book.—Messrs. Whittaker & Co, have just published "Electric Wiring, Fittings, Switches, and Lamps," by Mr. W. Perren Maycock, M.I.E.E.

Penistone Electrical Company.—This firm has now completed the transfer of the electrical department to its new works at Huddersfield, and in conveniently arranged premises and with up-to-date tools and machinery, is occupying itself with the manufacture of switches, switchboards, fuse and distribution boards, galvanometers, volt and amperemeters, railway instruments and bells, with Mr. V. J. Delebuque as works' manager. About 60 hands are now fully employed, and this number will be largely increased when further alterations are completed and more machinery is installed. The old premises at Penistone are being retained for the wood working department, employing 60 hands. Offices and clerical staff are at Huddersfield.

Portable Plant.—*Tenders and Contracts* says that in carrying out the repairs of the Torcenay tunnel on the Eastern Railway of France, a portable electric light plant is employed. A railway truck carries a petroleum engine driving a dynamo, which furnishes current, both for propelling the truck by means of a motor and for lighting the works in the tunnel with four to six arc lamps or 20 to 40 incandescent lamps.

Schuckert Tram Schemes. — The British Schuckert Electric Company, Limited, which is now developing its business within our borders, has just issued a list in which it gives in tabulated form the names of towns where electric tramways have been constructed or equipped by the Elektrizitäts-Aktiengesellschaft vormals Schuckert & Co., Nuremberg, in France, Germany, Spain, and other Continental countries. The total number of such lines running or under construction on January 1st, 1899, was 56, with a length of 476 miles and 1,121 motor cars. The table before us gives the year of opening, length of track, number of cars, H.P. of motors, station and accumulator KW. capacity, and other notes.

Steam Lorry at Messrs. Johnson & Phillips.—Messrs. Johnson & Phillips have started a steam lorry in their cartage department. The lorry is built to carry 4½ tons and has been supplied by the Liquid Fuel Engineering Company. We understand that the firm are very well satisfied with the innovation. The heavy load which can be dealt with in a single journey has been found a specially valuable feature.

Trade Announcements.—The offices of the German Atlantic Telegraph Company have been established at Cologne, Stolkgasse 3—11.

Messrs. H. C. Yeo & Co., have removed from 34, Aldermanbury, E.C., to 38, Gracechurch Street, E.C.

The St. Helens Cable Company, Limited, notify that they have taken over the business carried on by Messrs. W. J. Glover & Co. for the past 80 years. The St. Helens Company will carry on the business of wire drawers, wire rope, electrical wire and cable manufacturers, rubber and insulating material, &c. The works will be under the direction of Mr. W. J. Glover and Mr. R. B. Glover. The electrical cable and rubber works at Warrington will be supervised by Mr. Heyl-Dia.

ELECTRIC LIGHTING NOTES.

Alderley Edge.—The supply of electricity has just been commenced by a company which has registered offices in Manchester. Works have been erected at Belmont, near Alderley Edge, and the company has secured the Board of Trade order from the Alderley Council, and has, therefore, full powers to supply in all parts of the district. The company has offered to supply the Wilmslow Council.

Bermondsey.—The Vestry will not offer objection, under certain conditions, to the proposal of the London Electric Supply Corporation to lay high and low tension distributing mains and to construct street boxes in Rothsay Street. The Electric Lighting Committee has sent a circular letter to the parishioners stating that the Vestry hopes to be shortly in a position to supply electricity. Inquiries from large firms have been received.

Birkenhead.—Colonel W. Langton Coke held a Local Government Board inquiry last week respecting an application by the Corporation to borrow £5,000 for supplying electricity to the outlying townships of Bidston and Noctorum.

Birr.—The question of lighting the town by electricity is to come before the next meeting of the Urban District Council.

Burton-upon-Trent.—Notice is given that the system adopted by the Corporation for the supply of energy under the Electric Lighting Order, 1890, approved by the Board of Trade on September 17th, 1892, has been revoked, and that the system henceforth to be adopted by the Corporation is that of a high pressure alternating current supply to sub-stations, distributing at low pressure to consumers and public lamps.

Cheltenham.—The accounts of the Corporation electric lighting department for the year ended March 31st, 1899, are as follows:—Number of customers, 302; 8 C.P. lamps, 18,980, say, 19,000; electric energy generated, 507,830 B.T.U.; used in street lamps, 192,712; sold to private customers, 183,122; used at electric works, 16,898; used at electric works, central offices, stores, &c., for lighting, and for testing and drying transformers, &c, 14,800; unaccounted for, 100,298 = 507,830. Number of public lamps:—Arcs, 134; incandescent, 13; maximum rate of supply, 360 KW.; total capacity of plant (including spares), 800 KW.

Coatbridge.—On the application of the Coatbridge Town Council, the Glasgow Corporation has agreed to allow its electrical engineer, Mr. Chamen, to advise that town as to the proposed taking over of the undertaking of the Coatbridge Electric Lighting Company. There was a small opposition—which proved unsuccessful—to the proposal in the Glasgow Corporation meeting, on the ground that it was against the usual principles at Glasgow, and further, Mr. Chamen's hands were already more than full of work.

Croydon.—At a meeting of the Croydon Corporation on Monday, the Lighting and Electricity Committee presented a report recommending that extensions be carried out to provide for the supply of electric light to the houses in course of erection on building estates which are being developed at Norbury. The cost of the necessary sub-stations, cables, distributors and other plant was estimated at £23,320. The Corporation adopted the committee's recommendation, and agreed to apply to the Local Government Board for leave to borrow the amount of the estimate.

Dawlish.—Messrs. Taylor & Field have been engaged to report on the subject of an electric lighting undertaking for Dawlish.

Dewsbury.—The Co-operative Society is sending a deputation to Barnsley to inquire *re* the working of the electric plant at the Barnsley Co-operative Society's establishment. Estimates have been got out for engine and boiler houses, and equipment, including two gas engines.

Diss.—The Urban Council's clerk has, in accordance with instructions, written to the Suffolk Electricity Supply Association, asking whether they are willing to light the whole or any part of the town with electricity, and has also advertised for tenders for lighting. He has received a reply from the company to the effect that it would not pay them to light the whole of the streets unless they could contract for a long term of years, on account of heavy expenses which would have to be incurred. They, however, recommended that the main streets, say, from the bottom of Mere Street to the top of Mount Street, and thence to Crown Hotel, should be lighted with six arc lamps, each of 650 C.P. These the company would be prepared to fix and light for eight months in the year for £65 per annum, and they would lessen the number of gas lamps in the town by about 15. The chairman remarked that if they accepted this offer they would largely increase the cost of lighting. An offer to light the existing gas lamps with oil was then discussed for 30s. per lamp on a two years' contract. This is to be further considered.

Epsom.—A Local Government Board inquiry was held last week into the application of the District Council to borrow £16,100 for electric lighting purposes. The only opposition offered was by two members of the Council. The Board has already sanctioned the borrowing of £2,500 for a site for the proposed works.

Forgan.—The Tayside Electric and Gas Light Company has the consent of the local committee to its application for a provisional order for electric lighting at Forgan.

Hastings.—A Local Government Board inquiry has been held into an application of the Town Council to borrow the sum of £38,613 in connection with the extension of the electric light works, which were recently acquired by the Corporation.

Glossop.—With regard to the transferring of the electric lighting order to a company, the Town Council has been notified that the Edmundson Company is willing to reduce the previous quotation 1d. per unit, and is willing to afterwards sell the concern to the Corporation at a valuation. The estimate of the engineer was that the cost for lighting Glossop would be £15,000 in round figures, and £1,800 more if Hadfield were included. After discussion, it was decided not to carry out a municipal scheme, but to negotiate with a company which would, and to include the Hadfield district in the lighting area.

Hampstead.—The Vestry is to proceed with the extension of electricity supply mains in a number of thoroughfares as yet unsupplied.

Handsworth.—The General Purposes Committee of the District Council having obtained a provisional order for electric lighting, it only remains for the Council to give its sanction in order that the work may be put in hand. This will probably be settled at the next meeting.

Kirkcaldy.—The Electric Light and Tramway Committee has had before it several offers from companies for carrying out the electric lighting scheme, from which it appears that electricity can be supplied cheaper than gas costs at present. Other offers are yet to come in.

Leigh.—The District Council's electric lighting scheme (£10,500) is making progress. The whole of the mains have been laid, and the generating station is almost completed. Lighting is expected to be commenced in November. It was originally decided to light only the compulsory area, but already an extension is proposed, and the electrical engineer has under consideration proposals to lay mains in other roads.

Littleborough.—The Council has passed a resolution authorising an application to the Board of Trade, under the Electric Lighting Acts, for a provisional order to supply electricity for both public and private purposes within the district.

Llandudno.—Last week Colonel A. J. Hepper, R.E., held an inquiry on behalf of the Local Government Board into the application of the District Council for leave to borrow, amongst other items, the sum of £11,250 for electric lighting and motive power purposes. Part of this amount (£8,000) is intended to provide plant for the supply of power to the Llandudno-Colwyn Bay Light Railway.

The District Council has resolved that application be made to the Local Government Board for sanction to borrow a sum of £6,066 to cover expenditure over and above the amount already sanctioned in relation to the electric lighting and refuse destructor works, and including further expenditure estimated to be required to complete the work in hand.

London.—In regard to the matter mentioned under "Mile End" last week, the Vestry decided to apply to the Board of Trade to revoke the order and grant one to the Vestry. The Whitechapel District Board has now considered the matter, and has resolved to invite a conference of the local authorities in the Tower Hamlets, about to be merged in one municipality, with the view to thoroughly considering the question, so that only one centre of supply will be wanted.

We read that work is proceeding upon the erection of a central station for lighting the Embankment by electricity. The works will be close to Charing Cross Railway Station. Both sides of the Embankment are to be illuminated, 28 arc lamps being placed on the kerb on the land side and 29 on the river side.

The Vestry of St. Martin's have, according to the *Pall Mall Gazette*, entered into a contract with the Charing Cross and Strand Electricity Supply Corporation for the electric lighting of the principal thoroughfares in the parish, acting on the suggestions contained in a report prepared by their surveyor, Mr. George Green. Dealing with the question of combining the destruction of dust, with the supply of electric light, Mr. Green pointed out that such a scheme had been successfully worked in Shoreditch, where the steam generated from the furnaces used for the destruction of house refuse had been utilised for the production of electricity. But St. Martin's parish, for several reasons, was neither suitable for the generation of electricity nor for the destruction of house refuse. According to Mr. Green's plan, 28 important thoroughfares will be lighted by 92 lamps. The lamps in the Haymarket and near the other boundaries of adjoining parishes will be joint-lamps, the cost of erection and maintenance being shared equally by the parishes concerned. The extra cost of lighting the parish by electricity will be £1,362 per annum for the first seven years, and afterwards £561 per annum more than the present gas lighting, but the lighting power will be increased by 79,000 candles. The streets will be lighted by direct current arc lamps of not less than 1,000 C.P. The Charing Cross and Strand Company are now busy laying a cable in Charing Cross and Whitehall, as far as the Horse Guards, which forms the boundary of St. Martin's on the south, and it is expected that the installation will be completed before mid-winter. The Highway Committee of the Westminster Vestry has under consideration the question of lighting the parish by electricity.

Marylebone.—It is stated that the Vestry will this week consider whether to invite the vestries and public authorities whose districts are supplied with the electric light by the Metropolitan Electric Supply Company, to appoint representatives to attend a conference to consider the question of the purchase of the company's undertaking for the benefit of the consumers and the ratepayers. Although this scheme may not prove practicable, it is said that there is some serious intention on the part of the London County Council to promote a Bill or a clause in a general powers Bill, to empower the metropolitan local authorities to combine, with the object of purchasing electric light undertakings whose sphere of activity extends over several districts. As far as the business of the Metropolitan Electric Supply Company in Marylebone is concerned, the Vestry will shortly consider a report dealing with the question of purchasing that portion of the company's works, plant, and distributing mains situated in Marylebone alone. Two valuations have already been made with this object in view. On behalf of the company, Messrs. Deloitte, Dever, Griffiths & Co., put the capital expenditure on the Marylebone section at £319,735, and they estimate the goodwill at £613,476, or a total of £933,211. Messrs. Whamond, Williams and Co., for the local authority, agree as to the capital outlay, but they only allow £323,845 for goodwill and other items, making a total of £643,580.

Manchester.—Mr. C. H. Wordingham, the city electrical engineer, is circulating a list of the charges for energy. These are as follows:—

1. A charge of 5d. per Board of Trade unit consumed, with a minimum charge of 8s. 4d. per quarter.
2. A fixed charge of £7 per annum per kilowatt of maximum demand, plus 1½d. per Board of Trade unit consumed. This method of charge works out to a sliding scale, whereby the price per unit diminishes as the number of hours of user per annum increases.

This is shown by two tables showing the number of hours which a consumer must burn his lamps in order to obtain current at a certain rate, and showing the average price per Board of Trade unit when certain hours of burning are reached.

In the case of motive power two special rates are in use:—

(*a*) The first relates to consumers who guarantee to use their maximum demand for not less than 48 hours per week. To these consumers the fixed charge is remitted entirely, and they are charged only a 1½d. per Board of Trade unit consumed.

(*b*) The second rate applies to consumers who use their motors for less than 48 hours per week. These consumers have the option of paying either by the fixed charged method, or at the rate of 2½d. per Board of Trade unit consumed, without any fixed charge.

An explosion took place in a conduit on Tuesday morning. No great damage was done.

Nenagh.—The proposal to introduce an electricity supply is being supported with vigour, especially by Mr. T. M. Tobin, who originated the project. Messrs. Clayton, Weldon & Co., of Dublin, estimate that electricity could be supplied at about 5*d.* per unit with steam power, but, as ample water-power is available in the district, the price could probably be made still less. The scheme will be dealt with at the next meeting of the Town Commissioners.

Newport (Mon.).—Messrs. Baker & Co. having intimated to the Electricity Committee that the charge for electricity supplied in the June quarter was £126, and that they would have to discontinue the use of electricity unless a reduction could be made in the rate, the Committee decided that, as Messrs. Baker's enormous consumption was almost entirely a day load, the rate should be reduced from 4d. to 3d. per unit consumed in the daytime, for a minimum of 6,000 units.

Penzance.—The Town Council has resolved to obtain powers to carry out an electricity supply scheme.

Plymouth.—On Friday last the electric light and tramway undertaking was publicly inaugurated. Everything went off well. The Mayor performed the necessary ceremony, and the chairman of the Electric Lighting Committee in a brief speech referred to the history of the scheme and some of the difficulties which had had to be overcome. The large party of municipal Councillors and officials and friends then proceeded in five cars over the route, and luncheon at the Guildhall followed. Various toasts were gone through, and a presentation of a bronze figure bearing an incandescent lamp was made to the Mayor in commemoration of the occasion. Mr. J. H. Rider, the electrical engineer who has piloted the scheme through its difficult stages, delivered a speech in response to a toast, and gave some details of the work carried out. He predicted a profitable future for the undertakings both in private lighting and in tramway working. The power station started with a total load, besides the 8,000 private lamps, on tramways and arc lamps equivalent to 17,000 incandescent lamps. That was a record load for any station in this country to start with. Mr. Ferranti replied on behalf of his own firm and the others who had taken part in the equipment to "The Contractors" toast.

Queenstown.—The Urban Council has decided to have notice served on the gas company annulling the gas lighting contract, and the clerk is to advertise for tenders for the lighting of the compulsory area by electric light from January 1st next. It was also decided to advertise for the balance of the lighting of the town for same period.

Shildon.—A long report has been submitted to the District Council by Messrs. Handcock & Dykes on the question of electricity supply in connection with a refuse destructor. Their estimate states that the annual supply, 10,000 tons of refuse, is equivalent to 2,000 tons of coal (1·5 lbs. of steam per 1 lb. refuse), and they recommend that plant be laid down for the supply of 2,000 10-C.P. lamps and 80 public lamps, at a cost of £12,000. An innovation, or, rather, a return to primitive methods, is the suggestion that the lamps should be charged for at a fixed rate (probably 3½d. each per week) irrespective of the number of hours during which they are alight. The matter has been referred to a committee.

(*Continued on page* 523.)

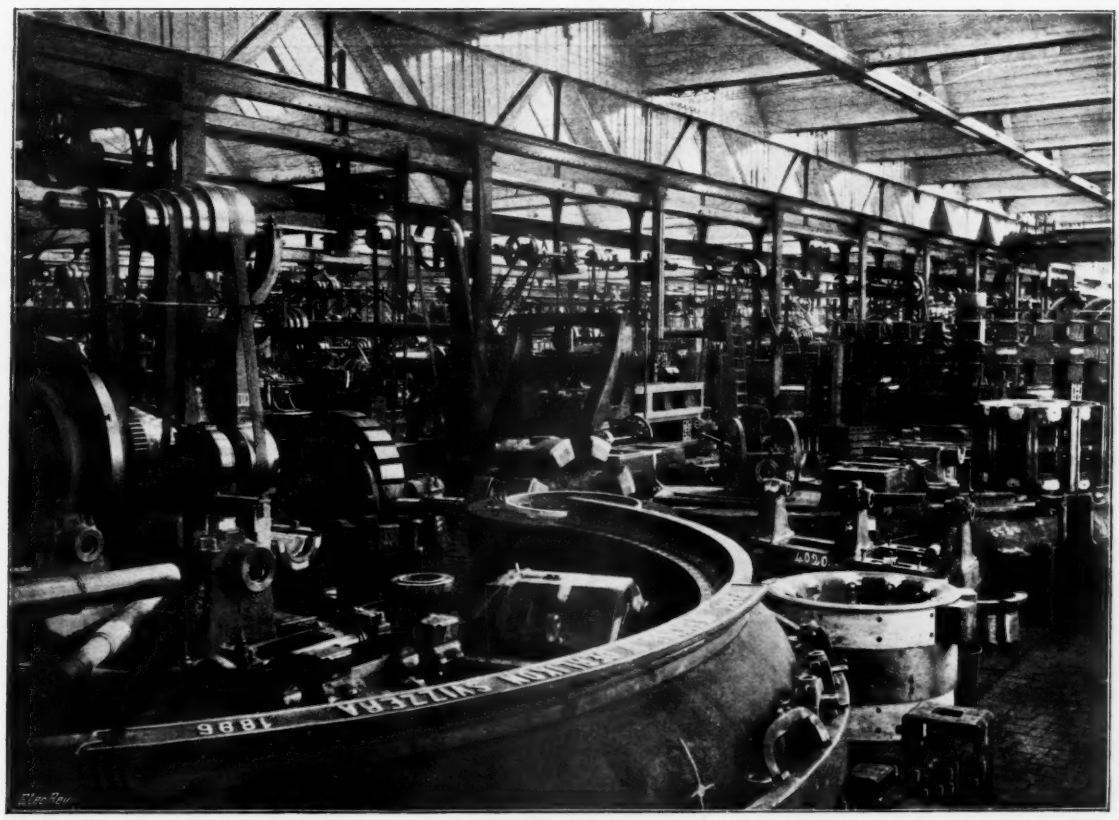
THE OERLIKON ENGINEERING WORKS.

By the courtesy of the management, we are enabled to give a number of illustrations of this famous factory, in which no less than 15,000 electric generators and motors have been built. The works was originally founded, in 1871, for the manufacture of steam engines and mechanical tools, and for general engineering business; a special feature from the first was the making of porcelain roller mills, of which over 14,000 have been turned out, and which are still an important part of the company's output. In 1880, however, the construction of electrical machinery was taken up with energy, and soon became the chief factor in the company's prosperity; as is well known, the Oerlikon works was among the first to make use of the applications of polyphase currents, and to push on the development of the induction motor.

The workshops, offices, &c., now cover an area of 8 acres. The number of workmen employed is about 1,800, under a staff of 250. Practically the whole of the machinery is driven by electromotors, mostly of the three-phase type. Part of the power is derived from a water-power plant at Hochfelden, 14 miles distant, where three turbines of 200 H.P. each drive three-phase generators. The current is transformed up to 13,000 volts for transmission to Oerlikon where it is reduced by oil transformers to 200 volts for distribution throughout the works. In addition, a 300-H.P. Sulzer engine and two large 10-pole steam dynamos with ring armatures are installed at the works, while a 600-H.P.

Oerlikon Tramcars, and Landes Museum, Zurich.

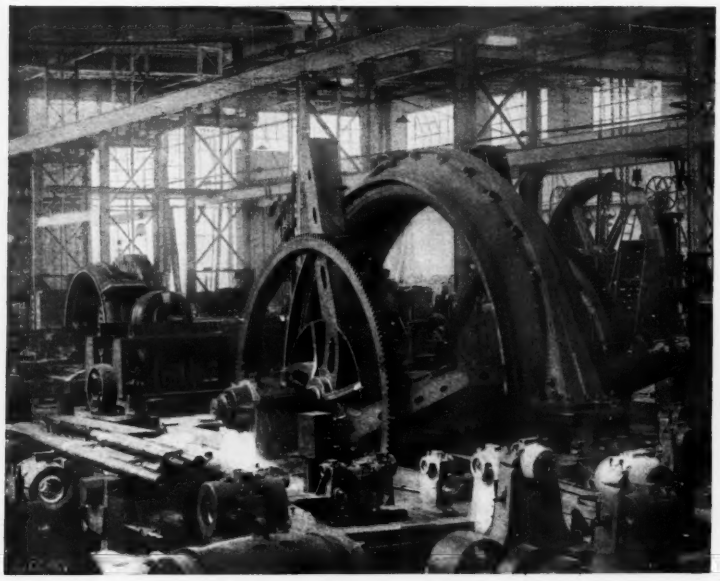
The Oerlikon Works.



Mechanical Workshop.

Stator in foreground, rotor on vertical lathe in background, of 1,000 H.P. 3-phase generator for Genoa.

steam alternator with fly-wheel armature and laminated poles is being erected to run in parallel with the transformers. The works are lighted with direct current at 125 volts. On the occasion of our visit we were surprised to observe the large proportion of multipolar direct current machines which were provided with ring-wound armatures. The most important type of machine, however, was, of course, the three-phase alternator, usually with inductor fly-wheel.



ELECTRICAL FITTING-SHOP.
Stator of generator for Letten Station, Zürich, on 21 feet boring lathe.

The Oerlikon inductor is built with a double set of armature coils, which can be separately removed without displacing either rotor or stator. Several induction motors were provided with a device, by means of which, after the motor had been run up to speed with external resistances, the rotor could be internally short-circuited, and the brushes raised. White metal is used almost universally for bearings. The cores of the stators of induction motors, which are always hole-wound, are bored out after assembly, until the roof of the tunnels is extremely thin; but it is not intentionally cut through. The radial clearance allowed is very small, usually about 0·6 or 0·8 mm. The travelling cranes, which are operated by three-phase motors, resemble the majority of those seen in the Swiss works, in having multiple flat-link chains for lifting. A simple device for avoiding eddy currents in cores due to burrs is seen in our view of the core-disc shop, in the shape of an automatic quick-stroke hammer with a large flat foot; the discs are moved about on the anvil until they are thoroughly flattened and the burrs beaten down.

A considerable amount of work has been done by the Oerlikon Company in laying down and equipping electric tramways, usually with direct current machinery; in some cases, however, the three-phase system is used, notably on the Jungfrau Railway, a locomotive for which was in the shops at the time of our visit.

There are 94 motors about the works, 860 lathes and other tools, and 18 electric cranes, with an average lifting power of 12 tons. The output of electrical generators, motors, &c., was 3,205 last year, and direct current machines have been built weighing up to 115 tons. It is remarkable that the

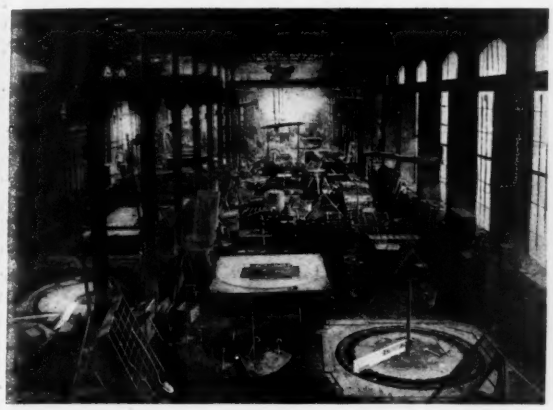
MECHANICAL WORKSHOP.
Field carcase of 810-H.P. dynamo for Rheinfelden, in 21 feet vertical boring lathe.

largest alternator ever built at Oerlikon was 96 tons in weight, so that direct current holds the record.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

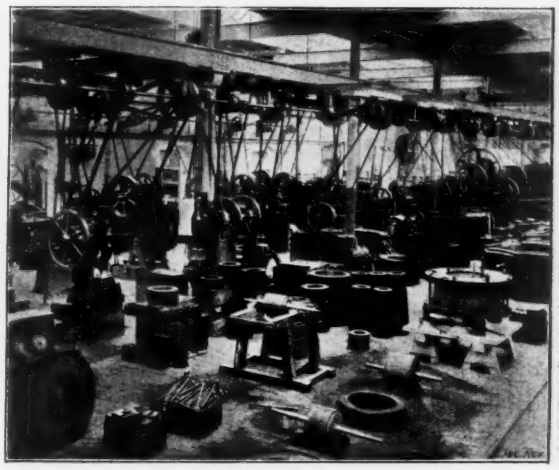
(*Continued from page* 468.)

The first item on the programme for Monday, September 4th, was a visit to the world-famed Oerlikon Works, of



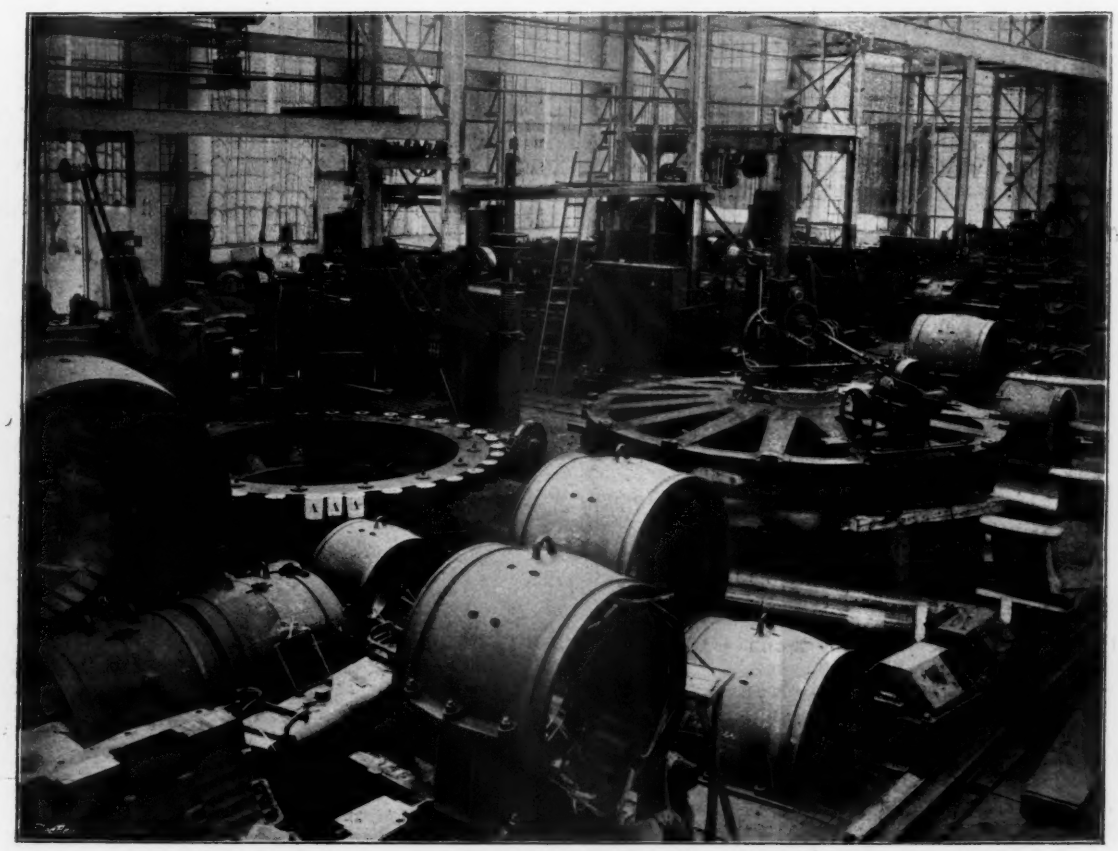
The Oerlikon Engineering Works.—Iron Foundry.

which we give some photographs showing the work in progress.



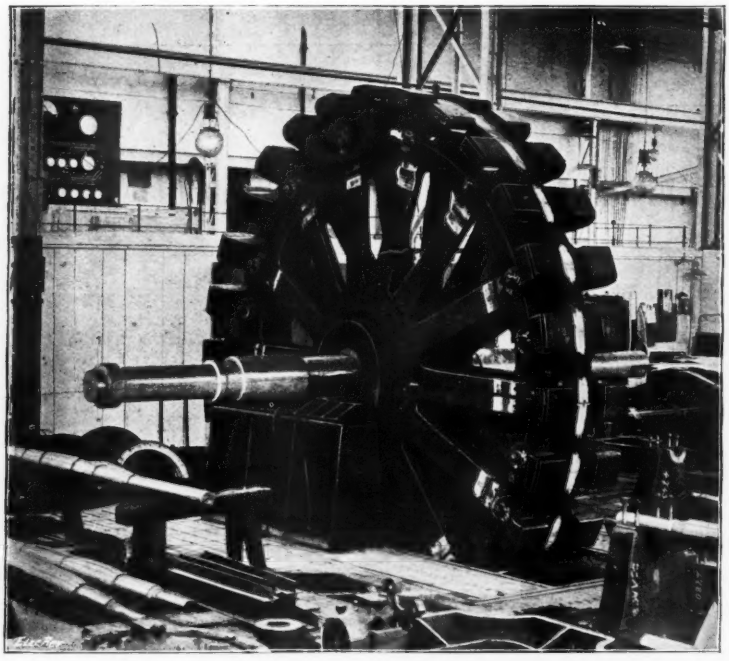
The Oerlikon Engineering Works.—Punching Department.

Before entering the works the party divided, and one section proceeded to the power station of the Zürich-Oerlikon Street Railway, a direct current overhead trolley line. There are three Oerlikon four-pole dynamos in the station, coupled direct to single-cylinder gas engines of 125 H.P. each, and running at 180 revolutions per minute. The engines are of the Deutz type, with hit-and-miss governors and electric ignition; each is provided with two heavy fly-wheels, and is insulated from the dynamo by the coupling, which is flexible, as appears to be usual in Switzerland. The dynamos have very wide commutators, with four sets of carbon brushes; they are provided with continuous ring lubrication, and are insulated by porcelain insulators from earth.



The Oerlikon Engineering Works.—Electrical Fitting-Shop.
1,000 H.P. 3-phase rotor for Schiffbauerdamm station, Berlin, with keyway shaping machine driven by 2½ H.P. portable motor. Stators of 250 H.P. 3-phase generators in foreground.

There is a large battery of Tudor accumulators, with an automatic regulating switch, and booster for charging. Dowson gas is used, the consumption of coal being 1·43 lbs. per B H P.-hour. We noticed that the current from one of the dynamos varied from 110 to 140 amperes at every stroke, while the current flowing to the battery varied from 15 to 40 amperes; the battery, therefore, practically annulled the irregularity as regards the feeders. The whole undertaking was carried out under the direction of the Oerlikon works, which was visited immediately after the power station; some notes about the works are given in the preceding article.



The Oerlikon Engineering Works.—Rotor of 1,000-h.p. Three-Phase Generator for Schiffbauerdamm Station.

The visitors returned to Zürich by tramway, and, having lunched, proceeded next to visit the works of Escher, Wyss & Co., where an unexpected variety of interesting features was met with. The operations of the firm are by no means confined to the manufacture of turbines; a large number of steam engines are also turned out. The respective figures are, since the foundation of the firm in 1805—2,800 turbines, of 250,000 H P., and 2,850 steam engines, of 195,000 H P.; while last year 103 turbines and 67 engines were built. The largest turbine was designed for 1,500 H P., and the largest engine for 1,200 H P.; it will be seen, therefore, that the work of the firm is of no small magnitude and importance.

Other products of this well-known factory are boilers, steamships, gas engines, paper-making machinery, &c. As might be expected, the works occupy a large area, about 25 acres; there is also a branch establishment at Ravensburg almost as large.

Amongst other interesting items we noted a neat automatic band saw sharpening machine, a pneumatic rivetter, hydraulic hammers, automatic shaping tools for wood and cast-iron bevel gear, and a lathe with revolving tools turning up a crank-pin. Casting has been elevated to a fine art; there is an immense foundry, and some of the castings were of great size and weight. One large fly-wheel, for 21 ropes, was 27·7 feet in diameter, and was cast in 12 segments.

The machines are electrically driven with three-phase current at 125 volts, power being transmitted at 5,000 volts from a turbine station at Bremgarten.

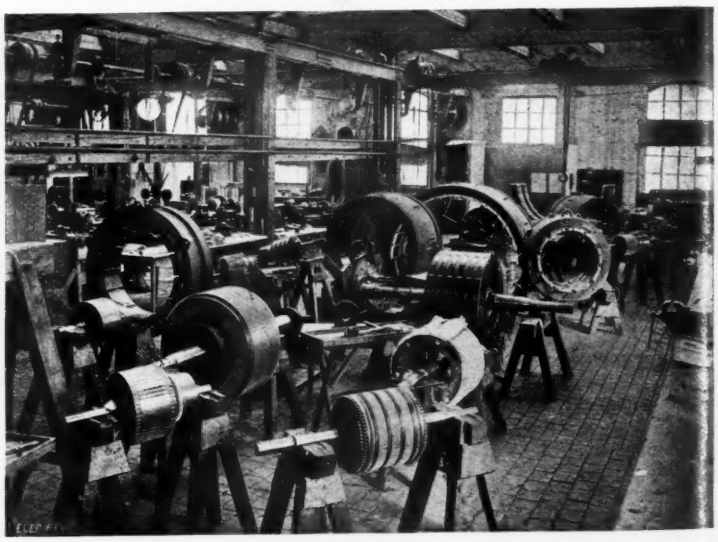
The next visit was to the Letten central station, which was especially interesting on account of the variety of the machinery employed. This station supplies electricity for lighting, traction, and industrial purposes to the town of Zürich, deriving the motive power from a number of turbines and three steam engines. The river Limmat is the source of power, the maximum available being 1,600 H.P.; Jonval turbines are used, with a fall of at most 10 feet. The electricity supply is carried out with single-phase current for lighting and power, three-phase for transmission to a tramway sub-station, and continuous current for direct supply to the tramway.

The single-phase machines have Kapp's ring armatures, while the three-phase generators are of the Oerlikon inductor type; the single-phase alternators are run in parallel with two phases in series of the three-phase machines. The conductors are laid entirely underground, and distribution is effected on the three-wire system at 100 volts. The steam engines are fine examples of Sulzer's work; two are rated at 1,000 H P. each, the third at 750. All are tandem compound condensing, with single crank, running at 100 revolutions per minute. A commercial efficiency of 94 per cent. at full load is claimed for the larger generators.

Many of the smaller sets are arranged in line, with clutches, so that the shafting can be coupled up or divided into sections at pleasure; the turbines have vertical shafts, and drive by bevel gearing.

The whole electrical output amounts to over 4,000 KW.; in addition, there is a large pumping installation in the station.

The sub-station at Selnau, mentioned above, was afterwards visited; here there were three motor-generator sets, supplying current to the tramway. Induction motors were used, receiving the three-phase supply at 2,000 volts, and driving the four-pole generators through flexible couplings.



The Oerlikon Engineering Works.—Armature Winding Department.

Each set had an output of 200 KW., at 370 revolutions per minute, with a commercial efficiency of 88 per cent. at full load; the efficiency of the motor itself was given as 95 per cent.

With this visit the day's work ended—a very creditable day's work, when the hot weather is taken into account, and

the tiring effect of sight-seeing and trudging from place to place.

On Tuesday a start was made for Schaffhausen. This proved to be one of the most enjoyable excursions of the tour, including, as it did, a visit to the beautiful Falls of the Rhine. The Schaffhausen station itself is situated above the Falls. The machinery for the town supply consists of one three-phase and two single-phase generators, driven through bevel gear by turbines with vertical shafts. A noticeable feature of the latter is the fact that the shaft is hollow, and the weight of the moving parts is carried upon a fixed internal shaft, which stands higher than the bevel gear. The maximum output is 900 H.P., while two other sets, which are to transmit power to a spinning mill close by, will have an output of 600 H.P.

An older installation consists of two direct current rope-driven generators with six poles, running at 700 volts pressure. The original station for which Schaffhausen was once famous, is still at work, transmitting power by ropes across the river and along the right bank; but even here electricity has made good its footing, for we find a three-phase alternator driven by a turbine, and generating at 450 volts. The turbine was provided with a hit-and-miss relay governor, the working of which was highly interesting; it failed, however, to control the pressure with less variation than 10 per cent.

The members of the party now indulged in a respite from their labours. Proceeding to the Schloss Lauffen, which dominates the Falls, they descended through wooded paths to the ferry, enjoying magnificent views of the Falls at vantage-points on the way. A few were heard speculating on the amount of horse-power running to waste, but most were content to admire and take snap-shots. Crossing by the ferry just below the Falls, the visitors ascended the hillside to the Hotel Schweizerhof, where a perfect view of the river was obtained, and where much-needed refreshment was provided.

A visit was made in the course of the return journey to Zürich to the works of Messrs. Sulzer Bros., at Winterthur. Prof. Perry divided the party into four groups with his umbrella and scientific accuracy, and a somewhat hurried progress through the works was made. As is usual on these occasions, although the sections started off in diametrically opposite directions, it was not long ere they came into collision and entanglement; members lose their parties, or *vice versâ*, groups wane and wax, and no one knows which section he will be in when he winds up!

The work done by Messrs. Sulzer is fully as varied as that of Messrs. Escher, Wyss & Co., and to a great extent of similar character, but, of course, the manufacture of steam engines is the leading feature. Some we saw in course of construction were of powers up to 4,000 H.P. for electricity works. The output up to the present amounts to over 4,000 engines of 500,000 H.P.; as many boilers, and a large quantity of steam-heating plant, rock-drilling machinery, steamships, &c., &c. About 4,000 men are employed by the firm, 1,000 of whom work in the foundry. As usual, electric driving is used, although the whole of the motive power is derived from coal.

(To be continued.)

Discharge of Torpedoes.—In the course of a paper on "Discharge of Torpedoes below Water," read at the B.A. meeting, Captain Lloyd said:—"For firing the inner tube we prefer using only electric gear, whether for cordite discharge or air discharge. It is absolutely necessary that safety arrangements should be provided to render it impossible to fire unless the sluice valve be entirely open and the running-in screw out of gear. These safeties can be provided with much simplicity and assurance with electric firing, whereas with mechanical firing gear they become complicated. In designing the firing gear we have provided a simple system of galvanometers, sounders, and batteries, which combine to automatically inform the operator in the conning tower, first, when the sluice is opened; second, when all is in readiness for firing, as well as to give those in the torpedo room an automatic test of the circuit and of the electric primer."

ELECTRIC LIGHTING NOTES.

(Continued from page 518.)

Ramsgate.—The Gas, Water, and Electrical Committee has resolved in favour of an installation of electric light for private and public purposes. The Corporation own the gas and water works, and propose also to municipalise the electric lighting supply. The Committee advises application for a provisional order.

The estimate of cost for the scheme which was brought forward by the engineer, Mr. W. A. Valon, who has had the consultative advice of Mr. Colson, of the Leicester electricity works, was as follows:—

Two water-tube boilers	£1,000
Two steam dynamos, each 75 KW.	3,000
Fuel economiser, feed pumps, feed tank, exhaust and feed and drain pipes	750
Steam travelling crane	900
Switchboard	1,000
Meters for dynamo and cell circuits, connection between dynamos, cells, motor balancer, switchboard, &c.	250
Battery of accumulators and motor balancer and booster	2,250
Underground feeder and distributor cables, feeder and house boxes	9,600
Superheaters fitted to boilers	250
Meters and services, say	1,000
	£19,300
Contingencies, 10 per cent.	1,930
	£21,230
Engine house, boiler house, foundations and buildings	3,500
Trench work for cables	1,500
	£26,230

Room has been left in the buildings plan for additional boilers and dynamos when required, while the cables will have capacity sufficient to provide for the supply of 10,000 lamps.

Ross.—The Urban District Council met last week to consider the report of Mr. Hamilton Kilgour, electrical engineer, Cheltenham, on the proposed electric light scheme for Ross. In his report, Mr. Kilgour recommended the three-wire continuous current system (low pressure), and estimated the extent of the main required at 3,300 yards (Ross Town 1,760 yards, Ashfield district 1,540 yards), the estimated cost being £13,000. The estimated financial results show:—Debit: Works' cost, £517; management costs, £199; interest and sinking fund, 5½ per cent. on £13,000, £747; total, £1,463. The estimated income, £1,573, made up of the supply to private customers of 60,000 units, at 6d. per unit, £1,500; street lighting, 7,000 units at 2¼d., £73. From these figures Mr. Kilgour considered an electric supply undertaking should prove successful at Ross, and be retained in the hands of the Council. Mr. Kilgour's plans provided 37 lamps for the streets. He considered it would be wise to include the Ashfield district in the area to be supplied. He explained three free wiring systems. It would take about 18 months to obtain the provisional order and the loan, if the application were made next November. It was pointed out that the present street gas lamps (14 C.P.) cost annually about 35s. each, and Mr. Kilgour said that if it was so low as that, it would not pay the Council to erect electric lights of 25 C.P.; they would have to come as low as 16 C.P. A meeting of the ratepayers will be called.

Scarborough.—An installation (400 lights) is to be put into the new Higher Grade School, Valley Bridge, for the School Board. Mr. G. F. Wells has the contract.

Sheffield.—The *Sheffield Telegraph* has an article calling for a more progressive policy in regard to the electricity supply scheme. The Electric Light Committee is said to be retarding the use of electricity in the city more than all other opponents, presumably by extreme caution or backwardness in carrying out extensions to new districts. It recommends a free extension of mains without waiting for a number of residents in each district to signify their intention to adopt the light. The article purports to contain the views of leading electrical engineers in the city, but whether that be the case or not, one has to bear in mind that the most successful electricity works in this country to-day are those which have been controlled in a progressive (we do not use the term politically) spirit by men who have shown no niggardliness in extending the mains into new districts. Edinburgh, Brighton, Manchester, and numbers of other towns might be cited as instances in support of this view. But in criticising the management of the Sheffield scheme, it is necessary to bear in mind all the local circumstances which have hindered progress. If we remember rightly, when the works were recently taken over from the company, the machinery was overloaded, and new plant of such a size as was necessary to cope with the increasing business could not be obtained at 24 hours' notice. When the Committee recently wanted to place an urgent contract for a large generating set with Messrs. Ferranti there was a storm in the Radical tea-cup, and among labour representatives generally at Sheffield because of the labour clauses which Messrs. Ferranti declined to accept. The facts of the case are perfectly familiar to our readers, and it is quite unnecessary to reiterate them again, but this is a point which attaches more blame to the Council itself than to the Committee. It would be anything but a wise policy on the part of the Committee to incur an enormous expenditure upon mains and main laying for new districts before there is a prospect of an approaching delivery of plant enough not only for the present area of supply, but for the demands of the proposed added areas as well. If there is to be a squabble at Sheffield every time a contract for generators is to be placed, then progress will indeed be slow, and the best thing the Committee could do would be to draw out a very big scheme, as some other towns have done, and place contracts—for alternators, or other generating plant which may be equal to the likely demand—for some years to come.

But the Committee or the engineer seem to us hardly culpable of retardation, unless it can be proved that the contracts for generators might have been arranged at an earlier date, and upon that point we have our doubts.

South America.—We gather from the *South American Journal* that the Cordoba Electric Light and Power Company is negotiating for the installation of electric light and power at Rosario. The same company, which is stated to be successfully operating at Cordoba with a water-power plant, is also negotiating for a water-power scheme at Tucuman. At Rosario, no water-power being available, steam driving is proposed. The company has, through Mr. Chas. Bright, entered into negotiations with a London syndicate for finding the necessary capital.

South Brent.—The extensive water mills known as Millswood Mills, close to the town, have been secured by Mr. W. H. Hawke, who has decided to undertake the supply of electricity to the town.

Torquay.—Major-General Crozier, R.E., holds an inquiry on behalf of the Local Government Board to-day respecting the application of the Corporation to borrow an additional £10,000 for electric lighting purposes.

Tunbridge Wells.—A temporary hitch took place in the lighting arrangements last week, resulting in a lowered steam pressure, and necessitating the extinction of 23 street arcs until the difficulty was overcome; this was accomplished within an hour, and the normal lighting restored.

Walsall.—Complaints have been made about defective electric lighting of the streets during the night. The defect is now being remedied.

West Ham.—The accounts for the half-year ended March 25th last show that the capital outlay on electricity works, &c., amounted to £42,491 4s. 3d.; the revenue for the last quarter was £1,996 4s. 8d., resulting in a gross profit of £346 3s. The net revenue account for the last half of the year shows a loss of £1,124 5s. 11d., due to the lack of revenue in the quarter ending last December.

Wigan.—Private enterprise is already ahead of the Corporation. Several establishments are laying down their own plant for lighting. The two principal hotels (Victoria and "Dog and Partridge") are in a forward state, and only wait delivery of engines and dynamos.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bedford.—A meeting is to be held in the Council Chamber on Friday, October 6th, to determine whether the Corporation shall apply to the Board of Trade for a provisional order authorising the Council to construct tramways, place and run carriages thereon, under the Tramways Act, within the borough and several parishes and districts adjoining.

Buenos Ayres.—The *Financial News* Buenos Ayres correspondent says that the City Council will shortly annul the clause in electric tram concessions making street lighting obligatory, and will impose a more equitable tax in its place. This clause has put a stop to all electric tram construction for the time being.

Cardiff.—The borough engineer (Mr. Harpur) has recently drawn up a plan showing the proposed extension of electric tramways. The plan has been approved by the Tramways Committee with minor alterations. The chairman of the Committee last week replying to certain newspaper charges of supineness in the matter of the tram scheme, said two years and three months must yet elapse before the Corporation could take over the company's lines, and until that time they could not run any cars on the proposed new lines. It would not be policy or in the interest of the ratepayers to lay out a large sum of money which would be lying idle for 12 months or so. The sub-committee which was appointed to visit various towns and prepare a report regarding the generating of power for tramway traction had already visited six or seven towns where electric traction was used, and had acquired a large amount of valuable information. They had two or three more towns to visit, and he hoped that their report would be ready in a month. The sub-committee were losing no time in making their inquiries, and there was very good reason why they should take no steps for the construction of the lines until they were thoroughly satisfied in regard to the stations for generating power. They believed that the whole of the work would be completed in 12 or 18 months, and they had two years and three months in which to make the tramways.

Croydon.—At the Corporation meeting on Monday, the question of the haulage system to be adopted for the tramways, which the Corporation had already decided to buy, came up for discussion on a motion proposed by Alderman Fors that a system of electric traction be adopted. The motion was promptly agreed to, but a further motion by the alderman that the overhead trolley system be adopted gave rise to some discussion. Most of the members were in favour of the overhead trolley, on the ground of cheapness and efficiency, and it was agreed to adopt that system, with the exception that the committee were directed to inquire as to some other system of electrical traction for one mile of the line in the centre of the town.

Driffield.—In regard to our note of last week respecting the Driffield Light Railway, Messrs. Bennett & Ward Thomas, consulting electrical engineers, of Manchester, inform us that the traction firm mentioned should be the English Industrials, and not the Drake & Gorham Electric Power and Traction Company.

Dublin.—The newspapers are giving considerable attention to the various mishaps which have been occurring in connection with the electric tramway system:—

On Tuesday evening last week an electric car, travelling from Nelson's Pillar to Terenure dashed into the Lord Mayor's carriage, which was waiting for his Lordship in front of the Mansion House. The coachman was thrown from his seat, and severely cut about the head. The shafts of the carriage were smashed. The horse fell, sustaining some injuries. The coachman had to be removed to hospital.

Another paper (we cannot vouch for the absolute accuracy of the report) says that—

On the 21st inst. an accident occurred to the electric tram system in Sackville Street, Dublin, and as a result traffic was suspended on several lines for almost an hour, causing considerable inconvenience to a large number of passengers. Shortly before 8 o'clock, p.m., a tram proceeding from Nelson's Pillar to Dalkey was passing the first post from the pillar in the centre of Sackville Street, when it suddenly came to a standstill. Almost simultaneously the gas lamp attached to the post mentioned flared up, and the flames extended several feet into the air. Whether this incident had anything to do with an accident to the arm of the post, or whether the trolley caught some portion of it, and the wrench that resulted caused the lamp to break, and the gas to flare up, are questions upon which there is considerable difference of opinion, but the electric wires were loosened from the arm, which appears to have been bent considerably, and the tram was brought to a standstill. The current was soon cut off, and as a consequence a serious stoppage of traffic on several lines took place. The service on the Donnybrook, Inchicore and Terenure lines was seriously disorganised for almost an hour, during which time the repairs to the wires and post were being executed; and the trams were also stopped to and from Blackrock and Nelson's Pillar. Rows of trams, all at a standstill, might have been seen in any of the principal streets from 8 o'clock till after the half-hour, and the passengers in the trams when the stoppage took place had perforce to finish their journey on foot. The escape of gas, consequent on the accident, was soon stopped; and shortly after 8.30, the breakdown gang having temporarily repaired the damage at the point where the accident happened, all the trams were again running.

Last week in the case of Caffrey *v.* United Tramways Company, heard at Dublin, defendants applied for an order remitting the action to the Recorder. The action was brought by a cabdriver for personal injuries received on August 15th through the alleged negligence of the defendants' servants.

The affidavit of Mr. Tresilian, secretary of the Tramway Company, set out that the plaintiff was on his car on August 15th in Lower O'Connell Street, when an accident occurred to an electric tramcar, and an interruption of the traffic was caused. It was believed that the trolley must have raised the trolley wire till it touched the guard wire, causing the latter to fall into the street. Plaintiff received no injuries from the wire, as it never touched him. He may have suffered from a small shock. An affidavit of Sir. Wm. Stokes set out that the plaintiff told him that he had been scorched in the arm, and had to remain in hospital until August 31st. Deponent found no trace of scorching on the plaintiff's arm, and no injury to his nervous system. The plaintiff, in his affidavit, stated that after the accident he lost consciousness till next morning. His head was not all right yet, and "pins and needles" continued to go through him, and he could not carry on his business as a cabdriver.

The affidavit of Dr. Louis Byrne, medical officer of the hospital, set out that the plaintiff was wholly unfit for work owing to shock and loss of power in the left arm.

Mr. Justice Kenny, without calling on the other side, refused the application, stating it was apparent that the plaintiff had suffered serious injury.

In another case (Ennis *v.* the same defendants) a similar application was made. The plaintiff sued for £500 damages for personal injuries sustained through the negligence of defendants' servants on June 20th, he being struck on the head by the trolley which, as defendants said, "left the wire inadvertently." Defendants said that if plaintiff had used proper diligence he would have avoided the accident. The following discussion occurred between judge and counsel:—

Mr. Justice Kenny: It seems to me that these trolleys are always inadvertently going off the wire. What does he mean by saying the defendants are not guilty of negligence?

Mr. O'Shaughnessy, Q.C. (for the plaintiff): Here is a passenger on the tramcar who gets his head broken in.

Mr. Justice Kenny: It is perfectly nonsensical.

Mr. Littledale (for defendants) said of course he was prepared for Mr. O'Shaughnessy's indignation.

Mr. Justice Kenny: No matter about Mr. O'Shaughnessy's indignation. It is apparent to anybody knowing anything about it. You will find very great difficulty, if it goes to a jury, to make them believe that passengers are always to dodge this thing.

Mr. Littledale read the affidavit at further length. It appeared that the plaintiff's life had been in danger. Mr. Justice Kenny refused the application.

It has since been announced that Mr. Trotter, Board of Trade inspector, has been appointed to hold an inquiry in Dublin as to the numerous electric tram accidents which have occurred in the city lately. The inquiry was to be held in the Arbitration Room, Four Courts, and was to commence yesterday.

Electric Omnibuses for Birmingham.—The *Birmingham Argus* says that it is the intention of the British Electric Traction Company to commence a service of motor omnibuses in Birmingham at no very distant date. The company are said to be simply waiting for an order of the Court to formally take over the Birmingham General Omnibus Company, and the work of constructing the vehicles will at once be proceeded with.

Electric Omnibuses in Berlin.—Trials were to be made this month in Berlin with four electric (accumulator) omnibuses. Four more are to be added later by the Berlin General Omnibus Company, which has the trials in hand.

Gas Traction in Germany.—We understand that, in view of the opposition still encountered sometimes to the introduction of trolley wires, Messrs. Siemens & Halske, the Union Electricity Company, and other Berlin concerns, have formed the German Power Gas Company for the purpose of promoting gas traction where other systems are objected to. This is a new departure for electrical firms; the future progress of the syndicate will be watched with interest.

Huddersfield.—The Town Council last week adopted the minutes of the Tramways Committee which contained a proposal:—

That the town clerk should forthwith take the necessary steps for promoting a Bill in the ensuing session of Parliament for obtaining the borrowing powers required to carry out the borough engineer's scheme for electric traction, and for extending the tramways undertaking to the following districts:—Section A, Slaithwaite and Marsden; B, Honley, Thongsbridge, Holmfirth, and Holme Bridge; C, Honley, Brockholes, and New Mill; D, Mirfield to the boundary; E, Brighouse; F, Kirkburton.

There is also a proposal to extend the trams to Rastrick. The undertaking was stated to be a very large one, and the scheme will be discussed further in the Council before being carried out.

Ilfracombe.—A project is on foot for an electric tramway from Ilfracombe Pier to the railway station. It is suggested that, as the Council possesses an electric lighting order, it should with advantage take up the tram scheme, combining the two.

Isle of Man.—Workmen have lately been employed by the Isle of Man Tramway Company in constructing a weir and carrying out certain other works in Laxey Glen, in connection with a scheme for the production of electricity by means of water-power. At present it is intended to erect two powerful turbines on the site of the "old paper mill," on the Claddagh, to be driven by water obtained from the Laxey river at a point about 100 yards below Mr. Rydings' woollen mills. Later on it is contemplated to utilise, in a similar manner, the other streams in the neighbourhood. It is estimated that the scheme, when carried out, will dispense with the use of steam for about nine months out of the twelve, and will thus effect a material reduction in the working expenses of the company.

Italy.—The water-power of the River Adda is to be utilised in connection with the adoption of electric traction on the Lecco-Colico, Sondrio-Colico, and Chiavenna-Colico sections of the Adriatic Railway.

Leeds.—The Corporation Tramways Committee, on 25th inst., considered the question of the electrical equipment of the tramlines, and it was thought that it would be better and more economical to deal with the whole of the lines at one time, instead of adopting a patchwork policy. With this object in view, a report had been prepared by the consulting engineers (Messrs. Hopkinson and Talbot) giving estimates. The proposed new lines measure approximately 17 miles. The Corporation now has 75 cars, a further 50 are being advertised for, and another 75 will be wanted in connection with the present scheme.

The report says:—

The total output of the plant now installed, or on order, amounts to 1,900 KW.; allowing one-half of this as spare, this will suffice to run from 95 to 100 cars. The regular service of 146 cars will required about 1,460 KW., and the whole 186 cars about 1,860 KW. If you put down two additional sets of generating plant, each of 750 KW., practically a repetition of the two sets now on order, you will have a total of 3,400 KW., one-half of which will be capable of dealing with 170 cars, and would no doubt be capable of dealing with more for a short time. By running two sets of plant, each of 750 KW., leaving two similar sets and the original rope-driven plant as spare, you will be able to run the 146 cars required for the regular service very easily. In dealing with the number of cars the various combinations of plant will run, we have made no allowance for the use of trailers. If these are used, further power will be required. It may be as well at this point to consider whether it will not tend to economy of working if we instal a battery of such size at the power station, or a number of smaller batteries at sub-stations, as would be capable of dealing with such variations and gradual increments of load as will naturally occur during the time the various lines are being changed, and which will ultimately serve as a reserve of power when the changes are finally completed. If such were installed it would undoubtedly lead to better regulation of pressure, and would enable a smaller plant to deal with those temporary increases in the load which occur in every-day running, and if trailers were used at occasional times during the day would provide power to run them. We now come to the capital outlay required on the assumption that two additional sets, each of 750 KW., are put down, and a battery capable of giving 750 KW. for 1 hour, that is, a battery capable of running 75 cars for 1 hour. This battery would be placed at the generating station, as we understand that to place a number of batteries in sub-stations on the various lines will necessitate the employment of a number of attendants, and so add considerably to the running expenses. We have, however, this matter under our consideration, and hope to devise some apparatus which would not necessitate constant attendance at sub-stations. For the purpose of this estimate, however, we assume the above battery will be placed at the generating station.

ESTIMATE OF CAPITAL OUTLAY.—Two engines and dynamos, each of 750 KW., steam, water, and exhaust pipes; battery to give 750 KW. per one hour; boosters for charging battery, switchboards and instruments, addition to switchboard gallery; motor generators for Stanningley, with battery at Stanningley; underground feeders; overhead linework, including poles, brackets, &c., erected complete; getting out ground for feeders; 125 cars (this number includes the 50 cars now being advertised for; total estimated cost, £160,000. The above estimate is based upon the prices at which the work now in hand is being carried out. We have not included in the above any steam raising plant, nor any buildings or alterations to buildings, these matters having hitherto been dealt with by Mr. Hewson. It must be borne in mind that the space within the generating station is limited, and even to erect the two additional sets of generating plant above referred to would take up the whole of the unoccupied space at the end of the station, that is, assuming the present type of engine and generator is adopted. If the present rope-driven plant were removed, its space could be occupied by two generators, each of 750 KW., and a third of equal capacity could then be erected in part of the space now unoccupied, leaving the remainder to be used for the boosters and other plant. The ultimate arrangement of and the type of plant to be used in any contemplated extension is one which will demand very serious consideration, as although the space available is sufficient for the extensions herein considered, if it should prove ultimately that the present estimates are exceeded, the site may become too small for the requirements of the traffic.

The committee unanimously decided to request the Council to authorise them to take steps for equipping on the overhead electric system all the lines of tramway mentioned in this report, amounting to 34 miles of track.

Lees.—The District Council at their monthly meeting had under discussion a letter from the Hurst District Council stating that that Council was in communication with the Ashton, Oldham, and Hyde Tramways Company, which intended to go into other districts, with a view to the line being extended to Hurst and on to Lees. The matter was held over to the next meeting.

Manchester.—The City Council will meet specially on October 25th for the purpose of deciding whether to exercise its right to require the Manchester Carriage and Tramways Company to sell to the Corporation so much of the undertaking as the Corporation is entitled to purchase, and for the purpose of adopting, if so decided, a resolution to serve notice on the company to that effect. The Tramways Committee has refused to grant the Manchester Carriage and Tramway Company's application for a 10 years' extension of lease on very favourable terms, because the Council is already practically pledged to municipalisation.

Ormskirk and Southport.—An inquiry was held at Ormskirk on 25th inst. into the above electric tramway scheme, which is for passenger and agricultural traffic. The promoters are Messrs. Charles Birchall, Thomas Callender, and W. Winnard. Mr. R. H. Scotter, the engineer, described the scheme, which is to cost £42,000, the company having powers to raise £60,000 capital. Mr. T. O. Callender and Mr. Birchall also gave evidence, and Lord Jersey said that the Commissioners would have pleasure in recommending the Board of Trade to grant the order.

Sheffield.—A trial run was made on Thursday last week over the new line to Pitsmoor; this route is almost as steep as the Walkley route. Mr. Fell and his staff have been busily engaged on the Pitsmoor route for some days making preparations for the inspection of the track by the Board of Trade inspector (Mr. Alexander P. Trotter). The cables have been completed, and arrangements were made for the initiation of a service of cars on 27th inst. A portion of the new machinery needed to supply power for working an efficient service of trams on the Walkley and Pitsmoor routes has arrived at the electrical power station. It is hoped to have the whole of the additional plant working before the expiration of October, by which time a number of extra cars will have been delivered. At present the Tramways Committee are handicapped, both as regards the number of cars at their disposal, and the lack of machinery.

Spen Valley.—The opposition of the Dewsbury and Heckmondwike authorities to the British Electric Traction Company's projected light railway, which was about to take the form of a Bill promoted in Parliament, is likely to fall through, in consequence of the decision of the Cleckheaton District Council to confine its action to an appeal to the Board of Trade for the insertion of protective clauses in the order. The Thornhill, Liversedge, and Ravensthorpe District Councils have already entered into negotiations with the company. We hope, therefore, soon to see a liberal and homogeneous scheme carried out in this district.

Walsall.—The Town Council has unanimously carried the necessary resolutions for bringing about the municipalisation of the tramways undertaking of the borough now owned by companies.

Wycombe.—The electric lighting company has written to the Council asking whether it would approve of an electric tramline from West Wycombe to Loudwater, to be worked in conjunction with the electric light scheme. The Electric Light Committee considered the matter, and, owing to the narrowness of certain streets, was unable to recommend the approval of the scheme. The Council has referred the question back for further consideration.

TELEGRAPH AND TELEPHONE NOTES.

American Telephone Magnates for Europe.—A Massachusetts paper says that President John I. Sabin, of the Pacific coast telephone companies operating 60,000 subscribers in the States of Washington, Oregon and California, and President Charles J. Glidden, of the Erie Telephone System, operating 90,000 subscribers in the States of North Dakota, South Dakota, Minnesota, Wisconsin, Michigan, Arkansas, Texas, and Cuyahoga County in Ohio, which includes the city of Cleveland, were to sail on the *Lucania*, September 23rd, for Liverpool, their destination being Sweden and Germany. The paper mentioned, adds: "It is said the telephone development in Sweden and the City of Berlin exceeds that of any other country in the world. The telephone systems of Sweden, Germany, France and England will be inspected, and any features of value recommended for adoption in this country."

Cuban Cable.—The *Electrical World and Engineer* says that, with the aid of the United States Government lighthouse tenders, the Western Union Telegraph Company has completed the laying of the new cable between Miami, Fla., and Key West, more quickly than had been expected. The work of laying the line to Havana has been begun. The shore end will be landed at San Lazaro, on the north beach of Havana, to which point the old cable ends will be transferred from Cojemar.

Post Office Telegraphs.—The St. Luke's Vestry has refused its consent to the application of the superintending engineer of the Post Office Telegraphs for the laying of conduits or cast-iron pipes in Finsbury Pavement and a number of other thoroughfares in the locality.

Post Office Telephone Service.—The Post Office authorities, writes a correspondent in the *Financial Times*, "are evidently determined to lose no time in endeavouring to put into force the powers conferred upon the Postmaster-General by the Telegraph (Telephonic) Communication Act, 1899, by which an expenditure of £1,000,000 was sanctioned for the establishment of an improved and cheaper system of telephonic communication in the metropolis. What the intentions of the Department may be in regard to the provision of telephone exchanges remains to be seen, but it is possible that arrangements in this direction may be made, perhaps as a temporary measure, at the central and principal district post offices. The establishment of exchanges is, however, an easy matter as compared with the difficulties likely to be encountered in the laying of cables to connect the exchanges together and to connect subscribers with the exchanges, since this opens up the delicate question of wayleaves, and the proposal to open the footpaths and carriageways is being resisted by some of the local authorities."

At Chiswick on the 22nd, a letter was read from the superintending engineer of postal telegraphs, giving notice of the intention to take up roadways and footways in Chiswick for the purpose of laying down a system. The proposals of the Postmaster-General were welcomed by the Council. Later, a deputation of Chiswick subscribers to the National Telephone Company, headed by Mr. Seymour Darlington, of the Bedford Park Stores, Chiswick, waited upon the Council with the view of inducing them to retire from the position they have taken up regarding the underground wayleaves, the telephone company having given notice to their subscribers that, unless the Council agrees to their terms, the service might be altogether withdrawn.

After the deputation had been heard, it was agreed that a special meeting of the Council should be held to discuss the matter with three subscribers and a representative of the telephone company.

On Tuesday a further deputation waited from the National Company upon the Chiswick Council. The Council agreed to consider fresh proposals from the company *re* wayleaves, and will not meanwhile insist upon the removal of the poles.

The Proposed Reduction of Rates to India.—The following letter, dated Calcutta, August 31st, has been addressed by the Acting Secretary to the Calcutta Import Trade Association to the Secretary to the Government of Bengal in the Public Works Department:—

Sir,—The attention of the Committee of this Association has been drawn to an important published letter recently addressed to the Government of the North-West Provinces and Oudh by the Upper India Chamber of Commerce in connection with the movement lately set on foot for a reduction in the telegraph rates between India and Great Britain. Reviewing the position, the Upper India Chamber asserts that "1s. per word rate, while constituting a great convenience to trade, the general public, and the Press, would yield to an independent line a volume of traffic sufficient to allow of the system being worked at a substantial profit." So far as regards the interests represented by this Association, the assertion that such a reduction would be a convenience to trade puts the case very mildly. The Committee have no hesitation, and there is certainly no exaggeration, in saying that a reduction from the present rate of R3 per word to the equivalent of 1s., *i.e.*, 12 annas per word, would prove not merely "convenient," but a powerful stimulus to trade. Having regard to the fact that the necessity of a reduction has been publicly admitted by the Viceroy and that sooner or latter the question will be dealt with both by Parliament and the Legislative Council of India, the Calcutta Import Trade Association, representing, as its name implies, a very large proportion of the trade of the port, most urgently desires to support the proposal of the Upper India Chamber of Commerce for 1s. per word rate, and the Committee trust that the Lieutenant-Governor will be pleased to communicate to the Government of India the views of this Association on this all-important question.—I have, &c., J. Taylor, Acting Secretary.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Otranto-Corfu	Sept. 16th, 1899 ...	Sept. 21st, 1899.
Corea-Japan	August 7th, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899...	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...
Siberian lines between Tschita and Nertschinsk...	Sept. 22nd, 1899 ...	Sept. 23rd, 1899.
Saigon-Bangkok	Sept. 25th, 1899 ...	Sept. 26th, 1899.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Bray.—October 2nd. The Urban District Council wants tenders for 12 months' electrical supplies. See "Official Notices" September 23rd.

France.—October 10th.—Tenders are being invited by the French Post and Telegraph Authorities, in Paris, for a quantity of telephone cable, and also of telephone insulated wire. Tenders to be sent to Le Sous-Secretariat d'Etat des-Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 H.H.P. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—Tenders are being invited for electric lighting plant, and fitting up same, for the lighting of three large tenements of shops and dwelling houses at Uddingston, for Mr. Watson, builder.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Glasgow.—October 10th. The Corporation wants tenders for the reconstruction of tramways according to specification. See "Official Notices" September 23rd.

Hampstead.—October 5th. The Vestry wants tenders for the supply of coal for the electricity works for one year. See "Official Notices" this week.

Huddersfield.—October 2nd. The Corporation wants tenders for five Lancashire boilers. See "Official Notices" September 15th.

Leeds.—October 18th. The Council wants tenders for 50 electric tramcars. See "Official Notices" September 23rd.

Leeds.—The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson Esq., M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th.

Rotherham.—October 9th. The Corporation is wanting tenders for Lancashire boilers, engines, dynamos, pumps, condensing plant, crane, economiser, battery, switchboard, boosters, feeders, mains, roadwork, &c., for electric lighting. Specifications from the Town Clerk on payment of £1 1s. for each of five specifications. The consulting engineer is Prof. A. B. W. Kennedy, at whose offices specifications may be seen. See "Official Notices" September 8th.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Swansea.—October 9th. The Corporation wants tenders for medium speed vertical engines, continuous current generators, booster and balancer. See "Official Notices" September 23rd.

Sydney (N.S.W.).—November 8rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invites tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 kw. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" September 8th.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes. See "Official Notices" this week.

CLOSED.

Barnsley.—The Council has accepted the tender of Messrs. Venner & Co., to supply Chamberlain & Hookham meters, at £5 2s. 6d. each (all sizes); and of the Reason Manufacturing Company to supply Wright's demand indicators, as follows:—5, 10 and

15-ampere instruments at £1 11s. 6d. each; 25 and 35-ampere instruments at £2 2s. each; 50-ampere instruments at £2 12s. 6d. each; 75-ampere instruments at £3 3s. each; 100-ampere instruments at £3 13s. 6d. each; 150-ampere instruments at £4 14s. 6d. each; and 200-ampere instruments at £5 15s. 6d. Councillor Brady said the lowest tender for meters was not accepted. Messrs. Ferranti were 2s. 6d. less than Venner & Co., but the former guaranteed to keep the meters in order for 7s. 6d. a year for 10 years, whilst the other, which had been accepted, guaranteed to keep them in order for 2s. a year for 10 years.

Chelmsford.—Mr. T. H. P. Dennis, of Chelmsford, has secured the contract to light the new railway station with electricity. There will be 190 lamps of various sizes and powers, and one arc light.

Dundee.—The *Contract Journal* says that the contract for the overhead line equipment and rail bonding of the following routes for the Town Council: (Section 1) Perth Road route, (2) Lochee route, has been given to Messrs. R. W. Blackwell & Co., Limited, Victoria Street, Westminster, London, S.W., (Section 1) £3,051 12s. 7d., (2) £2,879 17s. 7d.

Glasgow.—*The North British Daily Mail* says that the offer of the Barrowfield Ironworks, Limited, for the coal storage and water tanks for Pollokshaws Road electric lighting station is recommended to the Town Council for acceptance. The price is £5,838. The Sub-Committee on Corporation Works recommended the acceptance of the offer by Messrs. Cowan, Limited, Manchester, for four sets of switchboards, &c., for 1,100 H.P. engines and dynamo at Port Dundas Electric Lighting Station, the amount of the contract being £990; and also the offer of Mr. James White for four sets of switchboards and instruments for 400 H.P. and 200 H.P. engines and dynamos, the price in this case being £555 15s.

Hammersmith.—At the Vestry on Wednesday, tenders as under were accepted:—For main switchboard, Messrs. Ferranti, £1,180; Messrs. Cowan's tender was £1,420. For steam pipes, valves, &c., Messrs. John Spencer, Limited, of Wednesbury, estimated total £700, under a schedule of prices. For cast-iron exhaust pipes, Messrs. Rosser & Russell, Hammersmith, under a similar schedule, amounting to £200. For brickwork for boiler, Messrs. Babcock and Wilcox, £580. For concrete foundations, Messrs. Martin Wells and Co., £165. A letter had been received from Messrs. Babcock and Wilcox, stating that they had made an error of £120 in their tender. The matter being pressing, orders were given for the work to proceed on the lines of the original tender, and the question raised by Messrs. Babcock & Wilcox will be allowed to stand over until the completion of the work. For putting up a boundary wall along the cast-iron side of the approach road to the electricity works, 7 feet high; stock bricks, Messrs. Martin Wells & Co., £375.

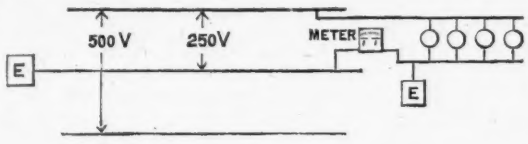
London.—The Battersea Vestry on Wednesday evening accepted the tender of the Edison & Swan United Electric Light Company, amounting to £3,588, for the supply and erection of switchboard and boosters at the electric lighting station.

NOTES.

The Electric Lighting (Clauses) Act, 1899.—In the article upon this Act which was published in our issue of September 15th, when referring to the provisions of Clause 7 of the schedule, the writer erroneously stated that "the limitation of profit to 5 per cent. will not afford any very strong inducement to private companies to undertake the supply of electricity." This clause, as a matter of fact, only applies to undertakings which are in the hands of the local authorities. Private companies are not in any way affected by it.

Windmills for Electric Lighting.—A correspondent of an American exchange recently asked for some information regarding windmills for electric lighting, as he had received various inquiries on the point from clients. In reply Prof. C. F. Brush, of Cleveland, Ohio, wrote, stating that his windmill storage battery plant for isolated lighting was still in successful operation after 11 years of use. During all this time he has not lost a single plate from the 408 cells of battery originally installed. This result is, he says, due to careful use. The plant is not, and was not, expected to be successful from an economical standpoint, because of its high first cost. The cost of any such plant, large enough to be of practical value, must always be large, and this feature, in connection with the skilled attention required, will, he thinks, prevent any extensive use of wind power for lighting purposes even in the country, where other sources of power are not available.

Connecting Up Meters on Multiple Wire Circuits.—A probable cause of the large proportion of "current unaccounted for" at some of the central electric light stations is the way in which the meters are coupled up on a multiple three or five-wire system, where the middle wire is earthed. Especially is this so when there is no fuse, or a comparatively large one, in the earthing circuit. No care is taken by



persons putting in the meters to see that it is put on the unearthed pole, and this should be done, since, if it is put on the earthed pole, and a substantial earth exists on that pole on the consumer's side of the meter, the latter becomes short-circuited as in the diagram, and does not register; this could not happen if the meters are put on the insulated pole.

"Allis, Where art Thou?"—An impossible reverie by a too partial chief:—

The switchboard man blinks drowsily,
The Pilot lamp gleams bright,
The peak is slowly falling,
And all's gone well to-night.
The ventilated armatures
Cooling my fevered brow,
Induce reflections o'er my mind,
Further extensions I must find—
But Allis, where art thou?

One year back this even
And thou wert by our side;
We thought the spec. would guard us, Allis,
Whatever might betide.
The load was slowly falling,
Just as it's falling now—and
The engine man slept gently.

* * * * * *

Oh, Allis! where *went* thou?

We sought thee in the boiler house
(The engine room was bare)
We 'phoned for news to Manchester,
You'd feel at home down there;
The wires, quivering, brought reply,
"We've high-speed sets in now;
Hundred-ton fly is all my eye."
So, Allis, where art thou?

In vain we sought through other towns,
We're going heavenward now;
Yoked to some star-wound dynamo,
Allis, we know art thou.

R. S. P.

Parsons Steam Turbo-Dynamos in Elberfeld.—The *Elek. Zeit.* recently stated that two Parsons steam turbo-dynamos, each of 1,000-KW., have just been completed, and will be started at the end of this year in the new central station in Elberfeld, Germany. The four-pole alternators have drum armatures, and make 1,500 revolutions per minute, the voltage at the poles being 4,000.—*Electrical World*, Digest.

Electrical Illuminations.—There have been great doings in the way of electrical displays at San Francisco. The principal thoroughfare was arched for a distance of 1¼ miles with strings of many thousands of incandescent lamps. Large search-lights were placed at intervals. The occasion was to celebrate the return of the 1st California Volunteers from the Philippine Islands, and the display lasted for three nights. The New York *Electrical Review* gives a photograph showing the effect.

Personal.—We hear that the Worcester Electricity Committee has appointed Mr. E. E. Hoadley, who is at present resident engineer to the Council at Barking, as *locum tenens* to Mr. C. J. Sutherland during his 12 months' leave. Before going to Barking Mr. Hoadley was chief assistant at Worcester for some 18 months, and he has also had experience at Islington and Eastbourne.

200-Volt Supply.—An "expert correspondent" of the *Pall Mall* inveighs against the conversion from 100 to 200-volt supply, which is now going on in various parts of London, and urges consumers to refuse to allow the change. He maintains that the advantage is all to the company, and not to the consumer. We entirely disagree with this view of the matter. The benefit is mutual, as the consumer will eventually discover. It is as useless as it is ill-advised to attempt to stay the adoption of new ideas and better methods; one can merely cause delay, with its attendant inconvenience and expense. At present it is a fact, though it is often overlooked, that the mains item is one of the very heaviest factors in the capital outlay upon which dividends must be earned; it stands to reason that, if by doubling the pressure the number of lamps which can be fed with the same network is quadrupled, the capital cost of mains per lamp is reduced to one-fourth. In this way a reduction in the cost of supply, followed by a lower selling price, is certain to take place in time; while an immediate gain occurs from the fact that, with the present number of lamps connected, the losses in transmission are reduced to one-fourth, and the steadiness of the supply pressure greatly improved. It is admitted that the offer of new lamps is advantageous, but it is also alleged that the lower efficiency of the 200-volt lamps more than outweighs the reduction in price which is put forward as an inducement to make the change. This may be so in some cases; those consumers, however, who persist in standing out for the low pressure will find the difference in price grow wider and wider, until there is no question as to which is the cheaper system. While the price of high voltage supply is sure to be diminished, that of low voltage will just as certainly *increase!* *Verb. sat. sap.*

Fire at a Niagara Falls Railway Power Station.—The handsome station of the Niagara Falls Park and River Railway at Niagara Falls, Canadian side, illustrated on page 305 of the issue of the Electrical Review of August 25th last, was destroyed by fire on the night of Monday, September 4th. The loss is estimated and placed at $90,000, and on this there was a total insurance of $38,000. Of this amount $30,000 was on the building and machinery of the Niagara Falls Park and River Railway, while $8,000 was on the generators of the Canadian Niagara Power Company, which company had a temporary installation of two 750-kw. generators in the station. The railway company had three 200-kw. generators, and a lot of necessary apparatus, &c. The fire started, it is supposed, from a short circuit on the alternating current line, and was first discovered in the basement by an attendant, who had barely time to shut down the station and throw the switches before escaping from the burning structure. The Niagara Falls Park and River Railway is among the possessions of the International Traction Company, and at the time of the fire President Ely happened to be in Niagara Falls. He at once set men to work stringing cables in order to make connection with the power service of the Niagara Falls Power Company on the American side of the river, and as these connections were promptly made there was little or no interruption to the service of the railway along the cliff on the top of the bank on the Canadian side. The generators of the Canadian Niagara Power Company supplied current to the Canadian branch of the Carborundum Company and other industries on the Canadian side; also to the Carmelite Monastry and for lighting the neighbourhood. Fortunately the old steam plant in the Niagara Falls, Ont., station had not been disposed of, and it was immediately brought into service. The Canadian Niagara Power Company and the Niagara Falls Park and River Railway are closely related, and it may be that in the construction of a new station the railway company will be governed by the plans of the power company, which is expected to soon commence a development on the Canadian side. The Niagara season is now about over, and the New York plant can supply a current service until a new station is brought into service.

Appointments Vacant.—The Barking Town Authorities are wanting a resident electrical engineer at £150 per annum, also a switchboard attendant, &c. See "Official Notices" this week.

The Electric Lighting of Tunnels.—Various attempts have been made to light the Batignolles Tunnel, near Paris, by electricity. As described in the *Revue de l'Electricité*, the first attempt was with arc lamps suspended from the tunnel arch, but the smoke and black walls allowed only a poor light to get to the interior of the trains, so that arc lighting in this way was impossible. Other trials were made, with the result that there is to be adopted an arrangement of 10 c.p. incandescent lamps placed a metre apart along the side of the tunnel. These lamps will be fixed at the height of the windows of the carriages, and will be automatically lighted and extinguished by the passage of the train. A number of pedals, which will be depressed by the rims of the wheels, work the switching gear. In this way any train stopping in the tunnel will be lighted fairly well from the outside, and much less electrical energy will be used than if the tunnel was continually lighted. The first installation will consist of 150 lamps only, but if successful, the full length of the tunnel will be lighted. While on this subject of tunnel lighting, we should like to add that some London railways would do well to give the matter attention, and more particularly the Great Eastern for its Bishopsgate tunnels. The G.E.R. is to be congratulated upon its efficient electric lighting at Liverpool Street, Bishopsgate, and Bethnal Green stations at night time, but the man who journeys cityward every morning sometimes says strong things about the inconvenience experienced in the tunnels and in Bishopsgate Street station when he wants to read the latest news from Paris and Johannesburg. It is bad enough to be suffocated with the fumes, &c., without enveloping the people in gross darkness at the same time. Why does not the G.E.R. adopt some system of train electric lighting so that the light can be automatically switched on as the trains enter the tunnels, and kept "on" until they leave at the other end? Or, failing this, the efficient lighting of the tunnels from end to end continously might be effected in some such way as is suggested for the Batignolles tunnel. Passengers would appreciate any improvement, and the cost would, we should think, be a comparatively small matter when one considers the vast proportions which the G.E.R. traffic has now assumed, and the enormous number of trains which have to pass through the tunnels every day. Some of our readers may remember the method of tunnel lighting in vogue on the Liverpool Overhead Electric Railway. The trains, on entering the tunnel (about half a mile long) are automatically lit up from copper conductors suspended from the roof of the tunnel, collectors being fixed on the roofs of the carriages. These lights are fed off accumulators, so that if a train should be stopped in the tunnel due to a "short" on the line, the carriages will not be in darkness.

Correction.—Messrs. Brown, Boveri & Co. call our attention to the fact that the majority of their alternators are of the ordinary fly-wheel type, and that they only construct inductor alternators in exceptional cases. We regret the obvious slip, which occurred in our notes on the Swiss Tour last week.

Electro-Harmonic Society.—The programme for this evening's Smoking Concert at the Society's new rendezvous, "The International Hall, at the Café Monico, Regent Street, W.," is a bright and cheerful one, the humorous element slightly preponderating. Recitations, violoncello and piano solos, ventriloquial sketches, ballads and humorous songs, ought to ensure an enjoyable evening for members and friends at the opening entertainment of the 1899-1900 season.

Chicago Prosperous.—Our New York namesake says that a careful canvass of the leading wholesale houses of Chicago shows that the increase in the volume of trade in electrical supplies for this year over the total figures for 1898 is estimated at $3,000,000.

Kashmir Railway.—We are informed that the whole of this project, of which we gave an outline in a recent issue, was carefully examined by Mr. R. E. Crompton during his recent visit to India, and that the decision to construct this, the longest electrical railway in the world, was not arrived at until after that gentleman had reported very favourably on the project.

The British Association.—Next year's British Association meeting is to be held at Bradford. It will open on September 5th, and Sir Wm. Turner, of Edinburgh, will be the president. Glasgow will be the place of visitation for 1901, and it will be remembered that that is the year of the great international exhibition of that city. Belfast may be the town for 1902, while Cork is also seeking the patronage of the Association.

Utilising Waste Gases.—We hear that a company has just been formed in Berlin under the auspices of Messrs. Siemens & Halske and the Union Electrical Company with the title "Die Deutsche Kraftgas Gesellschaft," to put down plants to utilise the waste gases of blast furnaces in driving gas engines and dynamos, &c.

Manchester Association of Engineers.—In the syllabus of this association for the 1899-1900 session we observe the name of Mr. J. S. Raworth, who is to contribute a paper on October 28th on "The Generation and Electrical Distribution of Motive Power." The meetings open at the Grand Hotel on October 14th with a social gathering.

Marriage.—On 17th inst., Mr. F. A. B. Lord (representative of Messrs. W. F. Dennis & Co.), was married at West Hackney Church to Miss Constance Stapleton, of Stoke Newington.

Wanted, Competent Telephone Engineers.—The New York *Electrical Review* says:—"Nothwithstanding the fact that the telephone in its present state of development affords, in many instances, a perfectly satisfactory service to the subscriber, there are many important problems in telephone engineering yet unsolved. This leads naturally to the inquiry: Why are there so few really competent telephone engineers? It is a most attractive field of work and offers certain rewards to those who enter it with a proper knowledge of their profession."

Paris-Berlin Telephone.—It is reported from Paris that negotiations for the establishment of telephonic communication between Paris and Berlin have been successfully concluded. The laying of wires will commence immediately.

Lecture.—On Wednesday, Prof. J. Wertheimer inaugurated the evening class session at the Merchant Venturers' Technical College, Bristol, by a lecture (illustrated by lantern and experiments) on "Tesla's Experiments with High Frequency Currents."

Darwen Electricity Works.—The public inauguration of the municipal electricity works and dust destructor plant took place on Wednesday, 27th inst.

NEW COMPANIES REGISTERED.

Alliance Fire Apparatus Company, Limited (63,647).—This company was registered on September 22nd, with a capital of £5,000 in £1 shares, to acquire the agency business carried on at Goldhawk Works, Shepherd's Bush, and elsewhere, by J. E. Spagnoletti & Crookes, for the sale of American fire preventing and extinguishing apparatus, and to carry on the business of electrical and general engineers, &c. The number of directors is not to be less than three nor more than five; the first are H. S. Smith, J. E. Spagnoletti and G. L. Beasley; qualification, £500; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Aluminium Company, Limited (41,104).—This company's annual return was filed on August 9th, when the entire capital of £300,000, in 20,000 preference and 10,000 ordinary shares, all of £10 each, was taken up; £132,220 is considered as paid on 13,222 shares, and £10 per share has been called up on 16,770 preference and eight ordinary; £167,780 has been paid.

CITY NOTES.

Belfast Corporation Electricity Accounts.

Gas and Steam Driven Stations.

The accounts of the Belfast Corporation electricity undertaking show important changes, and the comparison of 1898 with 1897 is noteworthy in the history of the undertaking, as it covers the transition period between the old and the new order of things. Our readers will remember that Belfast originally started with a gas engine plant laid down upon the recommendation of Prof. Kennedy. A new station designed by the borough electrical engineer, Mr. Victor A. H. M'Cowen, containing steam plant, was started in July, 1898, and the increase in capital expenditure is, therefore, considerable, but is more than met by the extra output and rapidly rising gross profit.

The general state of the undertaking is shown by the following figures:—

	1897.	1898.	Increase.
Total capital expenditure	£52,066	£96,277	£44,211
Number of units sold	201,832	356,526	154,694
Number of lamps connected	21,000	38,500	17,500
Gross revenue	£5,266	£8,225	£2,959
Gross profit	£2,292	£3,882	£1,590
Average price per unit sold	6·04d.	5·41d.	−0·63d.

The revenue from sale of current has fallen nearly two-thirds of a penny; the other items of revenue common to both years under review show together a drop of the tenth of a penny, but a small item of "supply of lamps" in 1898 gives a plus value per unit of the hundredth of a penny. As a net result, the gross revenue per unit has gone down nearly ¾d.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£5,076	6·04d.	£8·039	5·41d.	−·63d.
Meter rents	140	·16d.	171	·12d.	− 04d.
Supply of lamps ..	...	...	12	·01d.	+ 01d.
Sundry	50	·06d.	3	·00d.	− 06d.
Gross revenue ..	£5,266	6·26d.	£8,225	5·54d.	− 72d.

In the "Costs" statement the item of "fuel" includes gas used in the old station and coal in the new works. Mr. M'Cowen has included in the item of coal all that used for running the new plant and testing same. Notwithstanding this the cost per unit for the fuel shows a reduction of nearly ¼d. on the 1897 figures. Also he states that the cost of coal used per unit sold for 1898 works out at 0·88d. against 1·22d. for gas fuel used in the same year, or a reduction of 0·34d. per unit. He further hopes to improve very considerably on the fuel figures this year.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and Gas	£1,094	1·30d.	£1,583	1·07d.	− 23d.
Oil, waste, water, and engine room stores.	127	·15d.	213	·14d.	− 01d.
Salaries and wages incurred in generation and distribution.	656	·78d.	1,156	·78d.	·00d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	338	·40d.	291	·19d.	− ·21d.
Works' cost	£2,215	2·63d.	£3,243	2·18d.	− ·45d.
Rents, rates and taxes ..	283	·33d.	305	·20d.	− 13d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	339	·41d.	383	·26d.	− ·15d.
General establishment charges, stationary and printing, law charges and insurance	137	·17d.	391	·26d.	+ 09d.
Other expenses	...	...	21	·02d.	+ ·02d.
Total costs	£2 974	3·54d.	£4 343	2·92d.	− 62d.

The only increase shown in the costs' sheet are in the establishment charges and sundry expenses, notwithstanding the material rise in gross wages; the increased output kept this item at the same value per unit. The proportion of gas and coal may be indicated thus:—

	1897.	1898.
Units generated by gas ...	201,832 at 1·30d. per unit.	195,000 at 1·22d. per unit.
Units generated by coal ...	...	161,526 at ·88d. per unit.

The following figures are interesting:—

	1895.	1896.	1897.	1898.
Total efficiency	91%	93·8%	89·2%	89·4%
Loss in batteries	6·7%	3·9%	5·4%	5·3%
Loss in mains	2·3%	2·3%	5·4%	5·3%

The profits were appropriated as follows:—

	1897.	1898.
Interest on loans	£1,105	£2,786
Sinking fund for repayments	127	175
Hire of gas engines	...	518
Net profit carried forward	1,060	402
Gross profit	£2,292	£3,881

British Electric Traction Company, Limited.

The directors' interim report states that considerable progress has been made in various directions by the company and by its subsidiary companies. Lines have been opened for traffic by the Potteries Electric Traction Company and the Oldham, Ashton, and Hyde Electric Tramways, and the Dudley, Stourbridge, and District Electric Traction Company's tramways, referred to in the last report as in course of conversion, were opened for traffic by electric traction on July 26th, and the receipts have materially improved. The light railways are in active course of construction. The order for extensions of the light railways has been granted by the Commissioners subject to the approval of the Board of Trade. Several other lines are nearing completion, and it is anticipated that they will be opened for traffic before the close of the year. During the past session various additional powers have been secured. A concession for the construction and operation of electric tramways in the City of Nelson, British Columbia, has been obtained by the company and others interested in the undertaking, and the work of construction has begun. The existing tramways in Auckland, New Zealand, now worked by horses, have been acquired, and a new company has been formed, called the Auckland Electric Tramways Company, to take over the same, and also a concession for the electrical equipment of the lines and extension of tenure. The financial year will not close until March 31st next, but the directors have decided to pay an interim dividend on the ordinary shares for the nine months ended September 30th at the rate of 6 per cent. per annum. Warrants will be posted on October 2nd.

The Direct United States Cable Company, Limited.—The board have resolved upon the payment of an interim dividend of 3s. per share, free of income-tax, being at the rate of 3 per cent. per annum for the quarter ending September 30th, 1899, such dividend to be payable on and after October 24th next.

City Meetings.—Yesterday (Thursday) afternoon, meetings of the Halifax and Bermudas Cable Company and the Direct West India Cable Company were held at 33, Old Broad Street. The proceedings were private.

Reuter's Telegram Company, Limited.—The directors have declared an interim dividend at the rate of 5 per cent. per annum, tax free, for the half-year ended June 30th.

Eastern Extension Telegraph Company.—An interim dividend of 2s. 6d. per share has been declared for the quarter ended June 30th last.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 23rd, 1899, were £333 8s. 11d.; receipts for week ending September 23rd, 1898, £370 17s. 9d.; aggregate for half-year to date, £16,767 18s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 22nd, 1899, were £3,420 0s. 4d.; corresponding period, 1898, £2,992 16s. 6d.; increase, £427 3s. 10d.

The City and South London Railway Company.—The receipts for the week ending September 24th, 1899, were £914; week ending September 25th, 1898, £926; decrease, £12. Total receipts for half-year, 1899, £12,901; total receipts corresponding period, 1898, £12,312, decrease, £111. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 23rd, 1899, were £279 0s. 8d.; week ending September 24th, 1898, £216 12s. 6d.; increase, £62 7s. 9d. Total receipts to date, 1899, £7,662 1s. 0d.; corresponding period, 1898, £6,207 9s. 8d.; increase, £1,454 11s. 4d. Miles of track open, 1899. 8; 1898, 8. Car miles run, 1899, 5,280 1898, 3,813. Number of cars, 1899, 12; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 22nd, 1899, were as follows:—D. U. T. Co., horse cars, £1,143 6s. 0d.; ditto, electric cars, £2,009 11s. 1d.; D. S. D. Co., electric cars, £849 18s. 11d.; total, £4,001 16s.; corresponding week last year—D. U. T. Co., horse cars, £2 436 16s. 7d.; ditto, electric cars, £469 18s. 2d.; D. S. D. Co, electric cars, £1,059 0s. 7d.; total, £3,965 10s. 4d.; increase, £36 5s. 8d. Aggregate to date, £55,349 1s. 7d.; aggregate to date last year, £53,752 5s. 5d.; increase to date, £1,596 16s. 2d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 80 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending September 24th, 1899, were £584. Miles of track open, 10. Car miles run, 11,371. Number of cars, 21. The receipts for the week ending September 28th, 1898, were £270. Increase, £314. Miles of track open, 3½. Car miles run, 3,675. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £15,180; total receipts to date, 1898, from June 29th, 1898, £3,703.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 24th, 1899, amounted to £1,388: corresponding week last year £1,680 (visit of Channel fleet); decrease, £297.

The South Staffordshire Tramways Company.—The receipts for week ending September 22nd, 1899, were £667 15s. 3d.; aggregate receipts for 38 weeks, £25,352 14s. 6d.; week ending September 23rd, 1898, £645 17s. 11d.; aggregate receipts for 38 weeks, £23,946 8s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

Another week of steady, depressing dullness has fallen to the lot of the electrical markets. The magnetic influence of flat prices all round the Stock Exchange crept even into the Traction department. In fact, it is difficult to discover one solitary spot of cheerfulness in any of the electricity sections. Business remains as dull as ever, orders are few and far between, and when they come they are nearly all to sell. Telegraph issues have tottered somewhat, but, curiously enough, it is among them that the single rise has occurred that saves our lists from presenting an unbroken series of falls.

Supply shares maintain their nominal quotations hardily, even City of Londons being scarcely altered from what they were a week ago. The making-up price, however, favoured the bears, being fixed at 11⅜ against 11⅞, the making-up price on September 13th. Chelsea 4½ per cent. Debenture Stock has lost several points, but the company's shares are unchanged. Nor are Metropolitans altered, despite the talk of negotiations between the company and the Marylebone Vestry for the acquisition by the Vestry of the Metropolitan's work and plant in Marylebone. The market is looking on with languid interest, somewhat sceptical of the talk approaching a businesslike head. Definite information is not obtainable as to the date when the Charing Cross Company will make its new emission of capital, and the rumours afloat have no practical foundation. No quotable alteration has occurred in Nernst 7 per cent. Preference Shares, but the tone is easier in view of the special settlement on October 12th.

Eastern Telegraph stockholders are evincing grave anxiety at the outlook, and every day brings more and more stock into the already loaded market. Consequently, there has been another heavy relapse, and the price has given way ½ every day on an average during the last fortnight. Some selling has also taken place in Eastern Extension shares, the price of which has kept up remarkably well until the last few days. Anglo-American issues are weak, and the slump in Yankees is pointed to as the real cause of the fall. West Coast of America 4 per cent. Debentures furnish the one rise alluded to in our introductory paragraph, and the price has gone up 1 to 103½. African Trans-Continental Telegraph are worth keeping. The shares are, we believe, mostly in the hands of Mr. Cecil Rhodes, but a few were taken up by the public, and Mr. Stead's recent articles are likely to cause some demand for the shares as "long-shot" investments. Wireless Telegraphs are inanimate at 5½–6.

The railway market is chiefly notable for a fall in Waterloo and Citys to 101½, a price which seems quite high enough. Stock Exchange opinion leans to par as being a fair quotation for the stock, at any rate for another two or three years, until the line begins to stand on its own metals.

British Electric Traction Preference fell 5s. on a nervous holder attempting to realise his shares in a market that didn't want them. The Ordinary keep steady, and bargains are often arranged at the medium of the officially-quoted price. The interim report and dividend has no effect upon the price of the Ordinary. Tramway traffics continue good. Buenos Ayres and Belgrano reported an increase, up to August 27th, of £937, and the Ordinary shares hardened a trifle, to 3. Of all the electrified lines, this perhaps is the one most likely to produce the best results to a buyer of the shares to-day. The company is doing capital business, and the price of the Ordinary has every prospect of quietly advancing to par (£5). Anglo-Argentines are moving in the same direction, but their progress is very slow, and is likely to be until the electrifying work is completed, and the New Preferred stock can be issued. The traffic for last week showed an increase of £588, which is considered good. Tramways Union continue to dribble into the market, mostly in odd numbers, and the price is weak.

The telegraph and manufacturing department is steady to hard. Henley's new shares are 13. We understand that the certificates are on the eve of issue, and when they are ready the shares will be reinstated in the Official List. There is a small premium on the Preference of about 7s. 6d. Willans & Robinson are 10⅝. Telegraph Construction and Telegraph Manufacturing exhibit no alteration.

SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Sept. 20th.	Closing Quotation, Sept. 27th.	Business done during week ended Sept. 27th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	62 — 65	63½	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115	113½—114½	114½	113½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14¾	14½— 14¾	14⅝	14⅜
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	14½— 15¼	14⅜— 15¼	15⅛	14 13/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	104½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½ — 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11¾— 12¼	11¾— 12¼	11 15/16	11¾
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	145 —150	142 —147	146½	142
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	100½	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	117 —122	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14¼— 14¾	14 — 14½	14½	13 15/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
85,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	104¼	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10¾— 11¼	10¾— 11¼	11	10¾
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14¾— 15¼	14¾— 15¼	15¼	14¾
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30¼	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅞	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 7/16	5⅛
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100¾	100½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	101 —104	102 —105	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1¼— 1½	1¼— 1½	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅛	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10 1/8	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8⅝	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	113 —115	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13⅛	12⅞
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	82 — 85	82 — 85	82¼	82
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	8½	8
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	9 5/16	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6¾	6¼— 6¾	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14½— 15½	15½	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17	16 — 17	16¾	16½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	3 15/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 — 16	15 —16	15⅜	15¼

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 20th.	Closing Quotation Sept. 27th.	Business done during week ended Sept. 27th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜ — 3¼	2⅜ — 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½ — 18½	17½ — 18½	18	17⅞
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13⅜ — 14½	13½ — 14	14⅛	13¼
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	130	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½ — 6⅝	6½ — 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅜ — 2 xd	1⅜ — 2	1 1/16	1⅛
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛ — 2⅜ xd	2⅛ — 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	102 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½ — 14½	13½ — 14½	14 3/16	13⅞
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼ — 10⅜	10¼ — 10⅜	10¼	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	5 1/16	...
71,447	Do. do. Def. do.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
630,000£	City and South London Railway	Stock	1 9/16 %	1⅞ %	2⅛ %	64 — 66	64 — 66	65½	64½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼ — 6⅜	6¼ — 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4	3½ — 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2½	2 — 2½	2	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	4 7/16	4 3/16
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	97	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛ — 2⅜	2⅛ — 2⅜	2⅜	2 3/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	3½	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅝ — ⅞	⅝ — ⅞	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	100 —104 xd	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8½ — 8¾	8⅝ — 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½ — 13⅝	13½ — 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	38	36½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	103	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼ — 9⅜	9¼ — 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅞ — 6¼	5⅞ — 6¼	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	100 —103	102	101

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½% Debentures of £100, 103—106.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—3.

* From Birmingham Share List.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅝. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18⅜.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 27th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
" Nitric .. .. .. per cwt.	22/-	22/-	..
" Oxalic .. .. .. per cwt.	32/-	32/-	..
" Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	25/-	25/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a " " .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£24	£24	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3¾d.	3¾d.	..
a " Caustic (75/60 %) .. per ton	£24	£24	..
a " Bisulphate .. .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¾d.	8¾d.	..
c " Tube (brazed) .. .. per lb.	10¾d.	10¾d.	..
c " Wire, basis .. .. per lb.	8¾d.	8¾d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£88	..
h German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/3 to 4/4	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	67/10½	67/11½	1d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14	5s. inc.
g Lead, English Ingot .. .. per ton	£15 5	£15 5	..
g " Sheet .. .. per ton	£15 7 6	£15 7	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 12	£8 12	..
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/3½	From 1/3½	..
o Platinum .. .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£149 10	£149 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	9½d.	9½d.	..
j " " Russian, 10 lbs. .. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£13	£13	..
j " Manila, 24 thread .. per ton	£39 10	£39 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd,
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited,
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

THE BRITISH ASSOCIATION.

ELECTRICAL MACHINERY ON BOARD SHIP.

By Alexander Siemens, M.I.C.E.

(*Section G, September 20th.*)

Everybody is familiar with the great advance in comfort on board ship following the substitution of electric lights for candle and oil lights, and it is only natural that ever since the first application of electricity, endeavours should have been made to extend its use on board ship. The first part of the electric system to be developed was the generating plant, as it was very soon apparent that belt driving, otherwise universally resorted to, was not reliable enough. The motion of the ship affects the working of the belts, and often caused the same to leave the pulleys. As a first improvement, Mr. J. S. Raworth constructed rope pulleys for an endless rope, which could be stretched while running by means of a movable guide pulley. This rope gear, although it avoided the danger due to the belt slipping off the pulleys, shared with the belt driving the serious disadvantage of occupying too much space, which, considering the limited accommodation in ship engine-rooms, was a fatal objection. About the same time, Brotherhood engines, running at a high speed, were first used coupled direct to dynamos, but their construction at that time was not very well understood, and the ships' engineers greatly preferred double-acting engines of simple construction. To meet their views, and to economise space, Mr. Raworth constructed a friction driving gear, which has been extensively used, and merits therefore a short description. The dynamo is bolted to a cradle, which can rock the dynamo about an axis at right angles to the direction of the armature spindle, and this carries a pulley of compressed paper, which is driven by the fly-wheel of the steam engine, against which it is pressed by adjustable springs. The cradle supporting the dynamo is placed between the steam engine and the fly-wheel, so that the whole arrangement is very compact. After this gear had been in use for some time, Mr. Charles Hall, the electrical engineer of the P. and O. Company, suggested driving the dynamo direct by a Tangye engine at the comparatively low speed of 180—200 revolutions per minute. This type of generating plant has practically been adopted for all modern ships, and it may be observed in passing that direct driving is nowadays recognised, even in places where there is no want of space, as superior to belt driving for all purposes.

In view of the contention that English practice is lagging behind that of other countries, it is as well to remember that at the Chicago Exhibition the two or three direct-driven sets were almost ridiculed by the American engineers, who confidently predicted that the old country would soon drop this practice and adopt the American method of belt driving. As a plant typical of the American practice of that time, the power plant of the Brooklyn tramways can be mentioned, where Corliss compound engines drove a fly-wheel from which a belt 5 feet wide drives two dynamos on the first floor of the building. It is needless to say that direct driving is now as much in use in the United States as it is here, and, in fact, everywhere. There can, therefore, be little doubt that the type of generating plant adopted on board ship has reached a stage in its development which, no doubt, will be improved, but will not be materially altered.

When electricity was introduced upon Her Majesty's ships, some inconvenience was caused by the magnetic field of the dynamos, affecting the ship's compasses in cases where iron bulkheads happened to be near the dynamos, and extended to the neighbourhood of the compasses. In order to guard against eventualities of that kind, it is now usual to employ ironclad dynamos on the men-of-war. For the same purpose the distribution of the electricity is in most cases effected by the double-wire system, the flow and return wires being laid side by side to all points of utilisation. These conductors form the most valuable part of the electric system, through being easily adapted to the scanty accommodation on board, readily repaired without danger arising from their being damaged when they are properly fitted up, and easily tested to ascertain that they are in working condition. Such qualities contributed not a little to the speedy introduction of the electric light, but they are still more appreciated for the distribution of power. The larger the ships are, the more it becomes necessary to supplement manual labour by mechanical power, and it is a trite saying that modern ships are nothing but machine shops. Until lately it was usual to drive all this auxiliary machinery by small steam engines, or by hydraulic power, and this necessitated a network of piping all over the ship, which is difficult to arrange neatly, and which gives endless trouble through leakage. In addition, there are waste products from all the auxiliary steam engines, and their disposal requires additional pipes and complications. All this inconvenience is avoided by employing electric motors, and for certain purposes, where the load on the motor does not vary much, they have been generally introduced. That their use has not been more extended is due to the difficulties which arise from variations in the load on the auxiliary machinery. Taking the case of a winch used to warp a ship, it frequently happens that the strain on a cable increases sufficiently to stop the movement of the winch altogether, and this would cause the current through the electric motor to rise to a dangerous extent. It is impracticable to protect the motor by a fuse, as the interruption of the circuit through the blowing of the fuses would allow the strain being taken off the winch, and in most nautical operations it is necessary to keep the strain on. There are two methods in use to overcome this difficulty—one is to employ shunt-wound motors, running continuously, and operating the winches, &c., through friction clutches; and the second is to employ special cut-outs in connection with series-wound motors. By these cut-outs the current through the motors is not interrupted altogether, but if the winch or other machinery is stopped so that the current becomes excessive, the main circuit is interrupted and a by-pass only left, in which sufficient resistance is inserted to allow only the maximum safe current to pass.

As an example of the first method, a steering gear and rudder indicator may be mentioned, which are constructed on similar lines, the indicator being, so to speak, a working model of the steering gear. A shunt-wound electric motor replaces the usual steam engine and turns the main shaft of the steering gear backward or forward by means of clutches, which are actuated by currents sent from the bridge. The current through the magnets actuating the clutches is interrupted automatically by the movement of the rudder-head, and a new impulse is wanted from the bridge before the steering gear will move again. For the convenience of the quartermaster, the contact-making apparatus on the bridge is designed in the usual shape of a small steering-wheel, so that it does not differ externally from the wheel used with steam steering apparatus. On the rudder-head a similar contact apparatus is fixed, which controls the solenoid clutches of the rudder indicator on the bridge, which is, as stated above, a working model of the steering gear, and shows the quartermaster the exact position of the rudder-head. Such an indicator has been in use on the ss. *Faraday* for some time, and has given complete satisfaction, so that it is contemplated to substitute the corresponding electric steering gear for present steam steering gear as soon as room can be found for larger generating plant. Here, again, appears an obstacle to the introduction of electric motors on board, and it can only be overcome by designing the engine room for the accommodation of powerful electric generating plant. There is every indication that this requirement is now being fully recognised, and that in future it will be possible to utilise electric motors in connection with all auxiliary machinery, and the absence of all pipework outside the engine room and boiler space will greatly increase the safety and convenience of working ships.

Sometimes it has been suggested that the main engines of a trans-Atlantic liner should also be worked by electricity, either on the plan adopted by Mr. Heilmann for locomotives or by means of accumulators. Although this may seem feasible at first sight, our present knowledge is not sufficiently advanced to make a practical test of either suggestion. Marine engines are the lightest per horse-power that are constructed. It would, therefore, not be possible to put smaller engines on board to generate electricity than those now used to drive the propellers direct. It is, therefore, self-evident that the Heilmann system cannot be economically applied for the main engines of ships. Equally impossible would it be to use accumulators for driving electric motors connected to the propeller shafts, as their weight would greatly exceed the capacity of the ship. This is easily shown by the consideration that a 6,000-ton ship propelled by 8,000 I.H.P. will take about 150 hours to cross the ocean, equal to 1,200,000 H.P.-hours. Fairly efficient accumulators give about 10 watt-hours per pound of their weight, so that a H.P.-hour can be obtained for 75 lbs. of accumulators. The ship in question would therefore have to load about 40,000 tons of accumulators for the trip across the Atlantic. No doubt there are further discoveries in store which will enable future electricians to attack the problem of propelling large ships electrically for long distances; for the present, it has only been proved to be an advantage to drive electrically the auxiliary machinery on board ship.

Discussion.

Sir Wm. White called upon Mr. Mark Robinson to open the discussion.

Mr. Robinson said he had very little knowledge of the subject of electrical machinery on board ship, but he knew something about direct-driving. He was glad Mr. Siemens had made allusion to the way in which England led in the matter of direct-driving, because he had seen accounts published of what had been done in America, in which it seemed that direct-driving had only taken its rise in America a few years ago. That was not the case. It had been suggested that they should drive livers across the Atlantic by accumulators, notwithstanding the difficulties. He felt pained that anyone had suggested that they should go across the Atlantic by that means. They might just as well have suggested the trolley wire; it was quite as practicable.

A speaker asked if it was easier in practice to repair the wires on board a ship than the pipes leading hydraulic pressure to the guns and different engines.

Sir Frederick Bramwell said he was inclined to doubt Mr. Siemens's assertion that the hydraulic pipes on board ship were subject to leakage. He had never heard that complaint, and he could not imagine that small joints like those could suffer. Steam pipes with an exceedingly high pressure did suffer, but he did not know it was so with hydraulic.

After a few further remarks from Sir Frederick regarding a method of operating winches sometimes employed for unloading the cargo from merchant ships,

Sir William H. White said that he had had a somewhat extended acquaintance with electrical machinery on board ship, it being one of the few responsibilities which he had to bear in connection with the Navy. He was inclined to think, although he was speaking from memory, that they began direct driving in the Navy at an earlier date than Mr. Siemens had mentioned, and he was certain they began the applications of electricity a good deal more than 20 years ago. The first application they made of internal lighting was in the *Inflexible*, which was designed in 1873, and was completed for sea about 1880. When leaving for the Mediterranean in 1880 or 1881, they got the first specimens of incandescent lamps on board for trial. The employment of electric power in warships gave, of course, the means of transmitting power for running motors with many obvious advantages. On the other hand, there could be no doubt that electric instal-

lations on board ship were exposed to very special conditions of trial, and that those conditions might involve their breaking down to an extent that land installations would not. Their experience in the Navy showed that it was absolutely necessary to have special fittings of watertight pattern for distributing boxes, and for many of the other electrical arrangements in the engine hold if they were to avoid accident and dislocation of the working of the machines. Of course, there could be no doubt that as to simplicity of leads, the smallness of space occupied by the wires transmitting the current and in many other ways in a warship, it was an enormous advantage to be able to use electricity. They could secure an amount of defence, and they could accept conditions, which were not possible with either steam or hydraulic power. On the other hand, up to date, those who had to do with the charge of electrical appliances upon board ship had been somewhat averse to its free and general extension, on the ground that they were not able to feel sure of continued efficiency and working, and of the apparatus holding good under all conditions met with on board ship. Therefore, the temporary policy had been to work up from the small end. There had been very great extensions of electrical power, much greater than people generally gave them credit for, as not merely was it the popular belief, as Mr. Siemens had said, that English electrical engineers lagged behind, but still more popular was the belief that they in the Admiralty lagged still further behind—in fact, that they were in the rear completely in this matter. That was not true. It might be said, speaking broadly, that the ships designed within the last three or four years contained very little steam-power outside the engine and boiler room departments. It was true, as Mr. Siemens had said, that the liberal use of long lengths of steam piping and of exhaust piping on board ship did not conduce to comfort or to coolness, but it was possible to do two things. It was possible to have your steam machinery within the engine room, to a very great extent, for example, by putting the steam steering engines in the engine room, and not right outside. It was possible to employ electricity for many purposes with perfect success. It could be employed, and with efficiency, for many purposes for which steam had hitherto been used. Take ships now building, the arrangement was of this nature:—All the ventilating fans (and there were a great many of them, outside the engine room department) were electrically driven; also the after capstan and some of the quick running coal hoisting machinery; in fact, he might say that the only steam pipes that were laid to any length in the ship were those that went to the cable working machinery forward. That in a warship was placed low down in the ship and there was no great inconvenience, but up to date they certainly did prefer steam machinery for cable and steering work. That was a matter of experience and choice. Coming to the working of heavy guns, there the feeling in the Royal Navy, amongst the individual officers in charge, was distinctly in favour of hydraulic power; but on the other hand, they were employing electrical power for the smaller kinds of guns that require power to be applied for working them, and they were employing electrical power in many of the operations for heavier guns, in the elevators of shot hoists, &c. They had electrical fittings in work for 24 to 28 tons weight. He was aware that foreign navies had gone so far as to employ nothing but electrical power for working guns. Those in charge of foreign ships had told him that they had been so worked with certain success, but in the English service electrical power had not been employed on guns above the 9·2-inch calibre. There was no doubt that, as they had reached the 9·2-inch size, so they would, in time, go on applying the same power to larger sizes. The Admiralty had other things to consider beside the mode of transmitting power. They had in hydraulic power a thoroughly successful system, which no claim ever made for electricity went beyond. They had no such difficulty in the leakage of hydraulic pipes as Mr. Siemens had mentioned. There had been cases in his experience where with pipes in the hot regions near boilers, and so on, the packing had suffered. They lived and learned, and took precautions, arranging the leads so as to get over the difficulty. With increase in steam pressure there was a good deal of heating and leakage from steam joints through very small effects, which with a slightly reduced pressure would be of practically no importance. Increase in steam pressure was in all its stages accompanied by difficulties, but experience enabled them to overcome them. Mr. Siemens had, of course, exploded the storage battery, in fact, he should say he had sunk it. Anyone who had made investigation had come to the same conclusion for himself. He well remembered when the first sample of "bottled" electricity was brought over here. He made his way to the people who had the best information on the subject. Their most sanguine expectations had made it clear that until there was a radically different storage battery introduced, it was not practical unless for special purposes, and largely for pleasure boats. There could be no doubt that in all those matters, that form of transmitting power which was on the whole best would establish itself. At the present time there were advocates for many kinds of power. Some favoured compressed air, some the universal use of electricity, some would have nothing but steam, and some, in their faith, hydraulics. He thought it might be said of the Royal Navy that they did not look upon any mode of transmitting power as of universal application, and they intended to adopt those powers which would lead to the best efficiency.

Mr. Siemens, in briefly replying, said that the Section had been very much obliged by the information which Sir W. White had given to them to complete that which he should have given in his paper but for the fact that in the several communications with which they were favoured from the Admiralty they occasionally received a copy of the Official Secrets Act. He was sorry he touched the hydraulic pipes. He had been duly squashed out in consequence. It could not be denied, however, that if the pipes did not leak, they occasionally froze. All precautions taken against freezing took up space. His principal objection to any pipe, whether steam or hydraulic, was that it took up space. He had stumbled over the various pipes himself. He had a great objection to them, and as soon as he was able to have all auxiliary machinery electrically driven he should do it simply for the convenience. Sir Frederick Bramwell said something about loading cargo. Mr. Siemens said that the electric winch would do the work in the same manner as the steam winch. The difficulty with the electric motor rose when the load on the winch or on the cable became so great as to stop the rotation. The danger then was burning out the motor, and they had to guard against that. As long as it could turn round it was all right. In regard to his statement about 20 years ago, that was approximate; he thought the first ship lighted by electricity was the *City of Berlin* with arc lights in 1877 or 1878, and he thought that the first ship of the Royal Navy lighted completely by electricity was the *Polyphemus*. He could only congratulate the section that Sir W. H. White had given a description as to how useful electricity was on board ship, and in spite of the great authority of Sir Frederick Bramwell, he thought that it would replace hydraulics in auxiliary machinery.

SOME RECENT APPLICATIONS OF ELECTRO-METALLURGY TO MECHANICAL ENGINEERING.

By Sherard Cowper-Coles, Assoc.M Inst.C.E, M.I.M.E., M.I.E.E.

(*Read in Section G, September 18th.*)

(*Concluded from page* 496)

Referring to fig. 6, A is the mould accurately shaped on its convex side to a true parabolic or other curve, and formed with a bevelled edge B; D is a circular concave sucker formed by a disc of rubber or leather, backed with a metal plate, and attached to one end of a

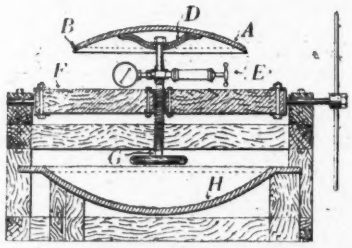


Fig. 6.

tube, which communicates with an exhaust pump E and vacuum gauge, and has its other end fixed to a screw rod G; F is a rotary wooden bar, having metal journals attached to its ends. These journals are mounted on plummer blocks fixed on the frame. A hole is bored through the centre of the bar F at right angles to the longitudinal axis, into which is fixed an internally screw-threaded metal bush. The screw rod, G, engages with this bush, and has a hand wheel attached to its free end. H is the tank containing the washing

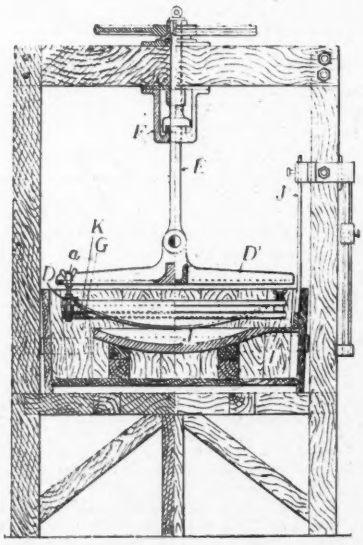


Fig. 7.

or silvering solution. When required for use, the bar F is rotated by means of the hand-wheel, until the sucker is turned up into the position shown. The concave side of the mould A is then placed on the sucker, and the air exhausted from between the mould

and the sucker by means of the exhaust pump; the mould is thus securely attached to the apparatus. When the glass mould is in this position it is cleaned, as previously mentioned in this paper. It is then, by means of rotating the bar, F, turned down into the tank, H, when its concave surface is submerged in the silvering solution and coated with silver by the process already described, and finally washed and polished.

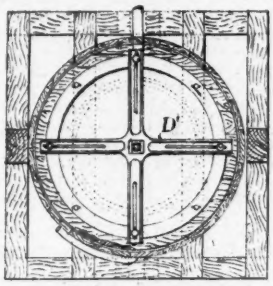


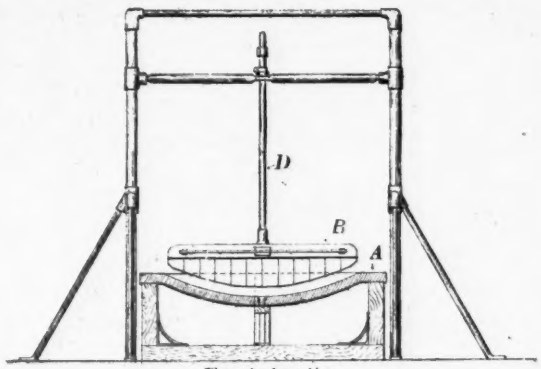
Fig. 8.

The mould is now removed from the sucker, and placed so that its bevelled edge fits accurately into the corresponding inner bevelled edge of the metal ring, D, figs. 7 and 8, which serves to support it in the depositing tank, while the metal backing of the reflector is being deposited.

The ring, D, is suspended by means of metal bolts from metal cross-bars, D^1. These cross-bars are connected by means of the metal bolts to a metal frame, which is hinged to the vertical shaft, E, by means of a pin, or pivot. This shaft passes through a box, F, and is carried on the main frame by means of a bearing, having balls, which support the shaft by a collar and allow it to rotate freely. A pulley is provided, through which the shaft and the mould may be rotated freely by a belt or cord. Attached to the ring, D, by means of small bolts are an annular baffle plate, G, and an annular stopping-off ring, K.

The distance of the plate, G, below the ring, K, is regulated by the thickness of the packing pieces. The object of the baffle plate is to prevent the formation of "trees," or "nodules," at the edge of the mirror, and the object of the stopping-off ring, or plate, is to determine the exact size of the mirror. Situated also in the tank is the anode, J, which (when a copper backing is being deposited on the mould) is of copper. This anode rests upon packing blocks, and has vertical rods attached to it, the free ends of which are adjustably secured in the metal brackets attached to the sides of the vat and one to the main frame. By means of adjusting these rods in the brackets, the distance between the anode and the mould or cathode, may be regulated. The tank is fitted with an inlet at the bottom of the vat, and outlet at the top, for the supply of the electrolyte; one terminal is connected to the mercury box, which is in electrical connection with the shaft, E, the cross arms, D', the bolts, *a*, and the mould forming the cathode, the positive terminal is connected to the anode by means of the copper strip, J'.

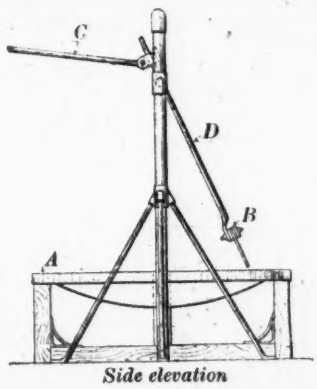
When first lowering the mould into the solution it is advisable to avoid throwing the work of carrying the whole electric current on the silver alone, so the shaft, E, is raised by means of pulley blocks to suspend the mould. The mould is then tilted and the shaft gradually lowered, bringing the edge of the mould in contact with the electrolyte, the circuit being thus established. A thin film of copper is deposited on the mould at the place of contact near the edge of the mould. The shaft is then lowered until it rests on the bearing, and at the same time the mould is allowed to resume its horizontal position. The operation I have just described occupies a very brief interval of time, and the current for a few minutes is worked at a pressure of about 9 volts, which is ultimately reduced. It is very important that the silver be flashed over with copper immediately on immersion in the copper sulphate solution. At this stage, the rings, K and G, are not applied, and the mould simply rests on the ring, D. The shaft is then rotated, and the operation of depositing the base metal continued with a current density of about 19 amperes per square foot, and is proceeded with until a sufficiently thick coating is obtained to act as a good conductor to the electric current. The copper solution generally used is of the following composition:—Copper sulphate 14 per cent., sulphuric acid 3 per cent., water 83 per cent. The ring, D, with the mould in it, is then lifted out of the bath and the rings, K and G, applied to determine the size of the reflector that is to be formed, after which the mould is again placed in the bath, and the operation of depositing the backing proceeds until the required thickness is obtained. During this stage the copper is deposited on the mould up to the inner edge of the ring, K, which thus determines the diameter of the reflector, and also ensures a clean even edge which requires no further treatment. After a sufficient thickness of metal has been deposited on the mould to form a suitable backing to the reflector it is removed from this tank, and the reflector backing separated by heating. The concave surface of the backing is now chemically cleaned, preferably with potassium cyanide or hydrate, and the backing, and then (referring to figs. 9 and 10) placed in an earthenware pan adapted to fit it, where a reflecting and protecting surface of platinum or palladium is deposited upon it. The tank, A, is supported on a wooden frame; its height being regulated by means of packing pieces. An anode is suspended from the main frame, and consists of carbon plates fixed in a holder, B, by means of lead strips. The carbon plates are arranged to form an approximate curve to the mould. The height of the anode can be adjusted by a vertical movement of the rod, D, which is attached to the holder, B. One end of a



Front elevation

Fig. 9.

connecting rod, C (fig. 10), is pivoted to the rod, D, and the other end is pivoted to a revolving disc. The disc is provided with a radial slot in which the pivot carrying the connecting rod is adjustable, so that by shortening or lengthening the distance between the pivot and centre of the disc, the throw of the connecting rod can be



Side elevation

Fig. 10.

regulated. The electric terminals are attached to the metal backing which forms the cathode and to the frame carrying the anode holder, B. If the reflector is to have a surface of platinum, the tank is filled to a sufficient depth with a solution of platinum composed of a freshly precipitated solution of double chloride of platinum and ammonium dissolved in a boiling concentrated solution of neutral citrate of sodium. If the reflecting surface is to be composed of palladium, a solution of palladium ammonium chloride is used. During this last process the anode is caused to swing backwards and forwards through the electrolyte by means of the revolving disc, in order to obtain an even deposit over the whole surface of the reflector and to keep the electrolyte agitated, and to prevent the deposition upon the reflecting surface of any foreign matter.

Seventy to eighty grains of palladium per superficial foot is found to afford a good protective coating. The silver-faced reflector previous to being placed in the palladium solution, is thoroughly washed with a hot, weak solution of caustic soda.

The back of the reflector is usually varnished before placing in the bath to prevent local action setting up between the copper, silver and palladium. When sufficient metal has been deposited the backing or reflector is removed from the bath and dipped in boiling water, and is then ready to be mounted in a suitable clamping ring such as shown in figs. 11 and 12; which is provided with a knife-edge, marked F, which holds the reflector against a ring of asbestos G, which is placed in a groove which retains it in position after the reflector has been carefully centred whilst resting on the asbestos ring.

Reflectors made by the process which has been described have been subjected to a number of tests, and have been found to withstand excessive heating without tarnishing. Salt water has been thrown on the reflectors when they have been too hot to touch, the result being that the water was driven off as steam, and the salt left behind as a white deposit upon the reflector, which was easily removed with a wet cloth. A reflector tested at Portsmouth had a number of rifle bullets passed through it when the parallelism of the rays was found to be but little affected. On the other hand the first shot fired at a glass reflector splintered it to pieces.

Some 3-foot mirrors made by this process for coast defence were placed in a projector case, in which was worked a 175-ampere lamp for six hours, during which time the temperature at the top of the reflector was found to be about 740° F. On removal the palladium-

faced mirror was found to be quite bright, with the exception of a few small stains, which were easily removed with a chamois leather.

Although palladium does not reflect light as well as a silver surface which is perfectly clean and bright, silver is found to be quite unsuitable, as after being in close proximity to an arc light for a short

Fig. 11.

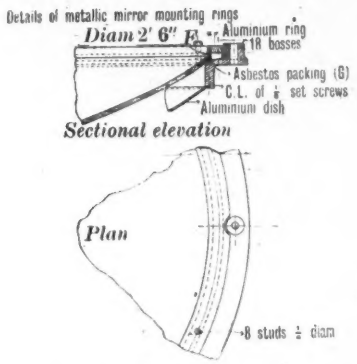


Fig. 12.

time the silver tarnishes and the light is greatly reduced in intensity. With a palladium-faced reflector the intensity of light is found to remain practically constant, as little or no tarnishing takes place. Nickel has been found quite unsuitable.

The following table gives the actual and comparative amount of light reflected from various electro-deposited metals; a Bunsen photometer and standard pentane lamps were used:—

Distance from Standard Light to Screen.—Direct Light (a), Reflected Light (b).

Actual Reflecting Power.

	cms.	cms.		$\frac{a}{b}$	$\left(\frac{a^2}{b}\right)$
Silver	69·5	71·5	...	·97	·94
Chromium	69·5	71·5	...	·97	·94
Platinum	69·5	97	...	·72	·52
Palladium	69·5	112	...	·62	·38

Comparative.

Silver ...	... 100 reflecting power $\left(\frac{a}{b}\right)$ taking Ag. as 100					
Chromium ..	100	"	"	"	"	"
Platinum ...	74	"	"	"	"	"
Palladium ...	64	"	"	"	"	"

The above tests were made on plates prepared by the same electrolytic method used for the manufacture of the reflectors.

Researches made by Prof. Potter give a loss of 31 to 35 per cent. for mirror metal, and Stephenson found for polished silver at an angle of 45° that the loss was about 44 per cent.

Platinum and palladium possess a reflecting power inferior to that of silver for visual rays, but superior for chemical rays, and for astrophotography.

Some experiments have been made to find out what effect the metallic surface directly under a reflecting surface of a thin film of an electro-deposited metal has on the reflecting power. A brass plate was polished, silver plated, and then thickly gilded and finished, and the amount of light reflected was then determined, after which the surface was coated with a very thin film of palladium, and the amount of light reflected determined again with the following result:—

Gold surface...	·77
Palladium surface	·63

The amount of palladium deposited on one side of the plate was so very thin that the gold could be distinctly seen through it; the measurement obtained from this was likewise ·63.

A metal reflector is lighter than a glass one. The weight of a 26-inch mirror is about 29 lbs., and the weight of the ring 132 lbs., making a total of 161 lbs., whereas the weight of a glass mirror is 165 lbs. without mounting.

Some of the reflectors have been tested optically by the process which has been extensively used by Tschikoliw. The method consists in photographing the image in a reflector of a white screen covered with a black square network, the lines being 0·2 inch thick and 0·2 inch apart. In the centre of the screen a square opening is left through which the photograph of the image of the network is taken through a pin-hole. The first step is to place the reflector at a distance of from 3 to 5 feet from the screen, which should exceed by at least 35 per cent. the height and breadth of the reflector, so as to ensure the image of the network covering the whole surface of the mirror. The test of the reflector is carried out as follows: The surface of the mirror in all planes is tried by a template to ensure that the exterior curves of the surface are not far distant from the parabola; the image on the screen is then photographed, and the irregularity of the lines indicates any serious errors of the parabolic surface.

Mirrors have also been tested by the Government test, that is, placing a number of annular rings of different diameters in front of the mirror, and reading on a scale the comparative focal length of the exposed portion of the mirror, an arc lamp being placed for this purpose at a distance of about 150 yards.

Messrs. Blondel and Rey have deduced from theoretical considerations that the brilliancy from any point of surface of the mirror, or of a mirror projector of the form due to Mangin, is practically constant, each point being considered as a source of light, and its brilliancy being measured in the direction of the optic axis of the mirror. They have recently tested this experimentally, and find that the brilliancy is constant, except at the mirror, and the central portion which is hidden by the negative carbon. To determine the brilliancy at any point of the surface, a sheet-iron screen was introduced at a short distance in front of the projector, so as to cut off all the rays except those coming from a small area surrounding the point. The rays were passed through a small hole in a sheet-iron screen, and formed an image of a crater on a photometer screen interposed at some distance. The illumination at the centre of this image was measured, and the brilliancy at a point of the mirror calculated. Finding the brilliancy at each zone of the mirror, the total candle-power of the projector is easily deduced.

On the table are some specimens and sections of parabolic reflectors made by the process I have just described; the specimens shown are faced with palladium, and one with platinum, there is also a section of a mirror showing the varying thicknesses of the metal.

I have here a parabolic reflector which has been fitted up as a sound locator for locating sound at sea. At night, or in a fog, it is very difficult to determine from what direction a sound comes, but by applying the flexible tube to the ear, which is attached to a small receiver and by moving the reflector in different directions, the direction of the sound can be readily determined; when the parabolic mirror is directly facing the source from which the sound emanates, the sound can be distinctly heard, and as soon as the reflector is moved away from the source of the sound, nothing can be heard through the receiver.

ON THE EXPANSION OF PORCELAIN WITH RISE OF TEMPERATURE.

By T. G. Bedford, B.A., Cambridge.

(*Section A. Abstract.*)

In direct comparisons of the scales of temperature given by air and by platinum resistance thermometers at high temperatures, the expansion of the porcelain envelope enters as a small correction.

In the experiments described in this paper, a direct determination of the linear expansion of porcelain was made at temperatures from 0° C. to 830° C. The method used was essentially the same as that described by Callendar (*Phil. Trans.*, 1887, A. p. 167).

On a tube of Bayeux porcelain two fine transverse marks were made at a distance about 91·3 cm. apart. The tube was heated to as high a temperature as possible in a gas furnace, and was then slowly cooled by diminishing the gas supply. During cooling the variation in the distance between the marks was determined by a pair of reading microscopes, which were mounted on stone blocks and not touched except by the screw-head during an experiment. The readings of the microscopes for a standard length (glass tube kept in melting ice) were taken at intervals.

The temperatures corresponding to the length measurements were deduced from the resistance of a platinum wire running from mark to mark in the axis of the tube and supported on a plate of mica. The resistances in ice and steam were taken after exposure to a high temperature. The sample of platinum wire from which the piece used in these experiments was cut is known to have a value of δ, in Callendar's formula from 1·50 to 1·51. The value $\delta = 1{\cdot}505$ was used, and thus a direct determination of the resistance at the temperature of boiling sulphur was avoided. An error of ·01 in δ causes an error of less than 1° in the calculated value of t at 1,000° C.

Four main experiments were made; the results were plotted and are reproduced on the accompanying slide.

From 0° C. to 600° C. the results are represented fairly well by the formula

$$l_t = l_0(1 + 34\,25 \times 10^{-7}\,t + 10\,7 \times 10^{-10}\,t^2).$$

Above 600° C. the points are more erratic, but still do not depart far on either side from the curve given by the above formula.

A length of about 6 cm. at either end of the tube was not directly heated by the furnace. Hence there is an uncertainty due to the ends (greater at the higher temperatures), since the coefficient of expansion varies with the temperature.

For cubical expansion the above formula gives

$$v_t = v_0(1 + 102\,75 \times 10^{-7}\,t + 32\,4 \times 10^{-10}\,t^2).$$

SIGNALLING WITHOUT CONTACT.

A System of Railway Signalling specially suitable for Fog Signalling.

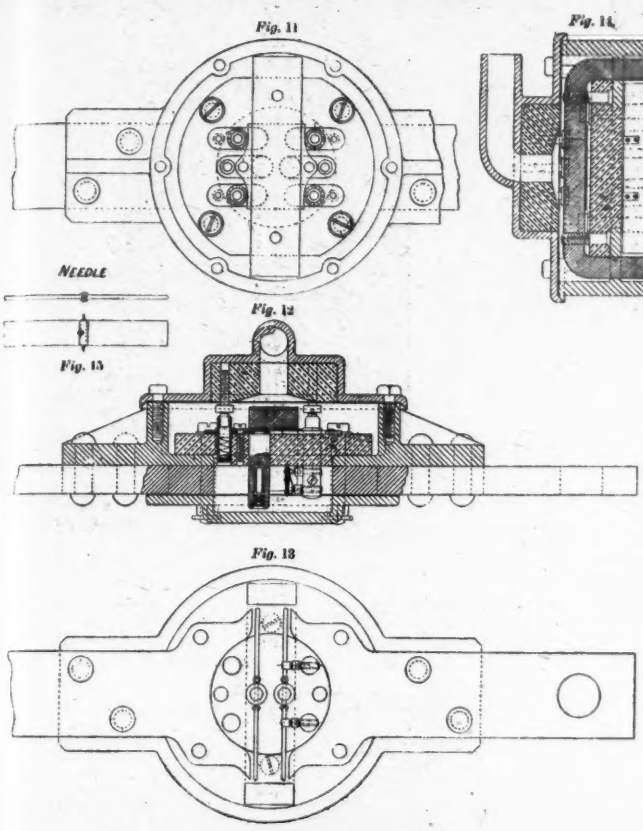
Paper read before Section G on Monday, September 18th, by Mr. W. S. Boult, Assoc.M Inst.C.E.

(*Continued from page* 494.)

Armature Relay.

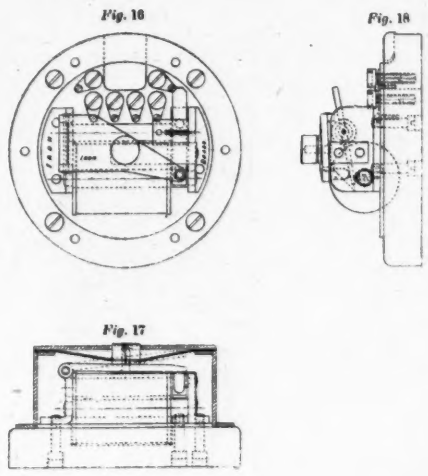
The construction of the armature relay is shown in figs. 11 to 15. The ends of the whole structure or bridge-piece shown, are attached to the longitudinal pole plates above referred to as shown in fig. 4.

Both the iron needles 3 inches long (see fig. 13, a view of the under side with cover removed), are both polarised and controlled (or held in the central position) by a single horse-shoe magnet, which, as its ends do not reach quite so low as the bottom edge of the needles (see fig. 14), to a large extent relieves the pivots of their weight. It will be noticed that the control of the needles is due to repulsion from the horns of the iron bridge bars near their ends which are similarly polarised by the magnet. This repulsion control allows a far wider play of the needles than an attraction control does, while at the same time simplifying construction. The needles may be thrown into absolute contact with the horns and not stick. There are four contact posts, against each of which a needle when thrown over by road magnets makes duplicate contact, so that for each signal there are four contacts, any one of which suffices for working. Connections with the circuit wires are made at the back or upper side of the ebonite slab on which the movement is mounted, by means of plungers such as are used in lamp-holders and insulated screws in the cover. Everything is enclosed in a jointed brass box.



Relay Push.

Figs. 16 to 18 show an apparatus for breaking a bell circuit at a relay or switch closed by the signalling current, and doing this in such a manner that the signalling current has always controlling power over the manual movement. For want of a better name it is referred to as a "relay push." It is constructed on a similar plan to the indicator movement above described, but has only one core and bobbin (with two independent coils in connection respectively with two separate batteries); a hinged flat iron bar taking the place of the second core. The polarised tongue acts as a switch in the bell circuit, being closed by signalling current passing through either or both of the coils on the bobbin. To open the relay, and thus stop the bells, the hinged iron arm is pressed down against the action of a spring till an iron stud on its end touches the tongue (which is not in contact with the iron of the core). It is then allowed to spring up, dragging the tongue with it. At any instant throughout, or after this operation, signalling current will re-make the contact.

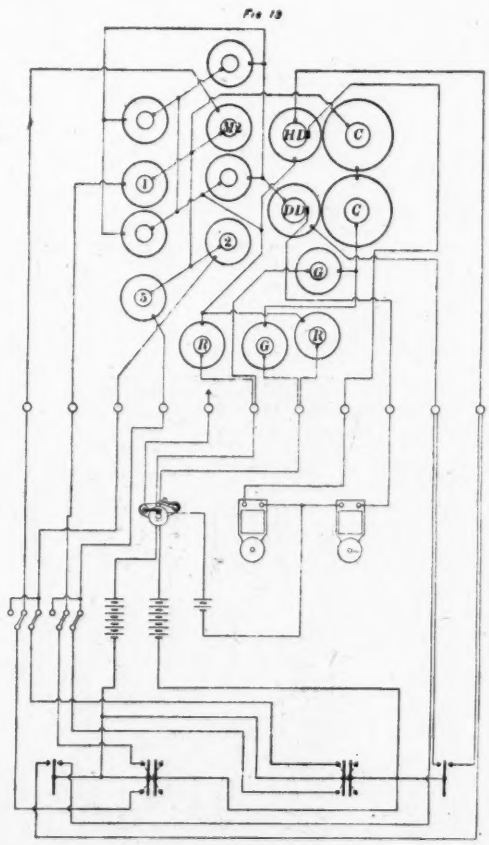


Engine Circuits.

The working of the whole apparatus will be best understood by a reference to fig. 19, which is a diagram showing the connection of all the parts on the engine.

The upper half of the figure shows the indicator coils connected with their terminals—a row of small circles extending across the diagram. At the bottom of the diagram are shown four armature relays carried underneath the engine, as shown in fig. 4. The two outside ones have single needles only, and work in duplicate to give the danger signals. The circuits from these needles will be right whichever end first the engine is running. The other two armatures have duplicate needles, and give the line-clear signal (both semaphores off) in conjunction with one road number. These circuits require reverse connecting for reverse running, switches for this purpose (which may be worked by the reversing lever of the engine) being indicated.

There are two batteries with their positive poles connected through the two coils of the "relay push" to the two "duplicate action" or spot movements, and their negative poles connected to the armature needles, so that for each signal one needle in connection with each battery is operated. Failure of one needle contact, one battery, or one connecting wire, is immediately shown by the "duplicate" spots showing different colours and thereafter remaining fixed, a green spot showing for the defective circuit and a red spot for the working one. The running signals will still be properly operated by the remaining circuit.



As this partial failure ought *never* to occur, it might be made a strict rule to run slowly in such a case.

Separate distant and home danger bells are shown, as well as the "relay push" for stopping them when the engine is standing, and doing this without interfering with the signal.

The numbers, M2, 1, 2, 5, indicate the respective coils for showing these numbers on the dial. H D and D D are the home and distant danger coils; C C, working together, give the clear signal; R R show red spots, and G G green ones.

(To be concluded.)

MOTOR CONTROLLERS.

In the early use of electric motors for power distribution, says the *American Electrician*, the motor itself was simply called upon to revolve and give power at a fixed speed. The adaptation of this power to the machines driven was effected by belts, cone pulleys, friction clutches, &c. Now that motors are direct coupled, or direct

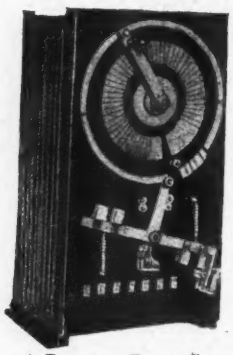


Fig 1.—A Printing Press Controller.

geared to machines, the speed or torque control, starting, stopping, &c., must be arranged for in electric circuits instead of in the mechanical connections. Different types of machines involve different requirements, necessitating a larger number of different controllers. Of these the Cutler-Hammer Manufacturing Company, of Chicago, Ill., makes a remarkably complete line, some of the newest instruments of which are illustrated here with.

Fig. 1 shows what is called a compound controller for large printing presses. The rheostat arm is fitted for controlling the speed of the motor by three different methods. In starting it first cuts out the armature resistance, then cuts out the series coils of the motor field, and finally inserts resistance in the shunt field circuit. Below this rotating arm on the controller is the main switch, consisting of a horizontal arm pivoted at its centre, the two ends constituting the two knives of a double-pole switch. This is closed by hand, by means of the upwardly extending handle, and is constantly pulled toward the open position by coiled springs. When closed it is latched by the

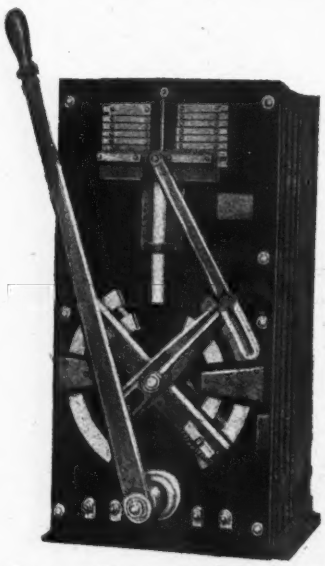


Fig. 2.—A Reversible Controller.

armature of a small magnet connected up with a number of switch buttons and contacts arranged to be automatically closed by broken paper or other mishap. The operation of this magnet releases the arm, which is pulled into the open position by the springs. A small overload magnet also acts as a relay to operate the same releasing magnet in case the motor is overloaded.

Fig. 2 shows what is termed a reversible controller, which is designed for cranes or hoists, and consists of a long arm linked with a four-arm dial switch, which serves in the usual way to reverse the armature connections. Pinned to the end of one of these four arms is a connecting rod, which serves to push upwardly a cross-head carrying carbon contacts on the rheostat connections at the top of the controller. The connecting rod is slotted, so that the rotating switch arm can only push the cross-head up, but cannot pull it down. It falls by gravity, and its speed is controlled by a dash pot. When, therefore, the controller is reversed, it pushes the cross-head up quickly to the top position, in which all resistance is inserted, and leaves it free to fall of its own weight against the dash pot, so that the operator is unable to quickly cut out the resistance and thereby

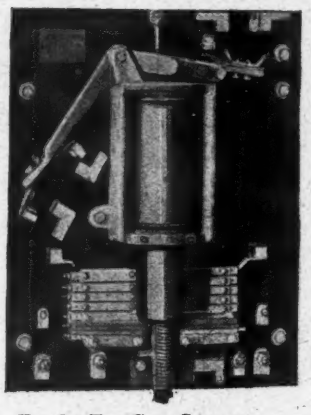


Fig. 3.—The Self-Starter.

overstrain the motor. The resistance is thus cut out automatically at a speed dependent on the weight and resistance of the dash pot, starting the motor smoothly at the proper rate of acceleration.

Fig. 3 shows an ingenious instrument applicable to many various uses, and termed a self-starter. It consists of a solenoid designed to attract a vertical plunger, which is connected with an L-shaped pivoted casting. The two arms of the L constitute the two poles of

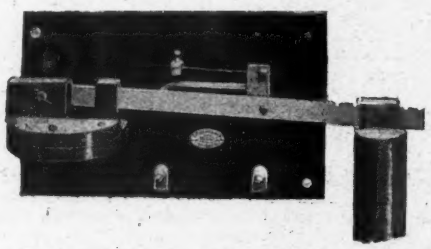


Fig. 4.—An Automatic Pressure Regulator.

a double pole main switch, with laminated copper contacts and secondary or following breaks of carbon. This is operated with a quick snap whenever the circuit of the solenoid coil is made or broken. The armature of the solenoid is also connected through a coiled spring with a cross-head at the bottom of the controller, carrying the contacts on the rheostat segments. When the armature rises suddenly, closing the main switch described above, it compresses this spring, gradually forcing up the rheostat cross-head, which is fitted with a retarding device so that the resistance cannot be cut

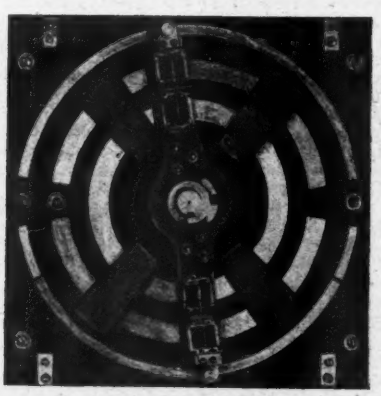


Fig. 5.—A Reversing Switch for Elevators.

out too rapidly. The circuit of the solenoid windings is necessarily closed while the motor is running, but the moving parts are fitted with contacts whereby—when the armature has risen and the magnetism need only be maintained at sufficient strength to hold it in the upper position—the current is greatly reduced, thus cutting down the waste of energy to a negligible quantity.

This instrument is applicable to elevators, motor-driven pumps or

other apparatus where it is desirable to start and stop a motor automatically. For pump service it may be combined with any float switch whose contacts need only control the small current taken by the solenoid windings, instead of the main current of the motor. For motors used in obtaining a constant pressure, either hydraulic or pneumatic, the pressure regulator shown in fig. 4 may be used on the same self-starter. This consists of a diaphragm forcing upwardly a weighted lever and operating a small snap switch on the circuit of the solenoid of the self-starter. For elevator service the same self-starter may be used with a reversing switch, such as is shown in fig. 5. Here the two inner rings operate to reverse the armature connections in the ordinary way, while the outer rings send current to the solenoid of the self-starter when the reversing switch is in either the up or down running position.

ELECTRIC LIGHTING OF WORKHOUSE COTTAGE HOMES.

The Shoreditch Vestry on Tuesday last week considered a letter read by Dr. Mansfield Robinson, vestry clerk, from the Shoreditch Board of Guardians (of which Mr. H. E. Kershaw is a prominent member) asking that the Vestry would grant permission to Mr. Newton Russell, the electrical engineer, to prepare a specification and estimate of the cost of installing the electric light in the Hornchurch Cottage Homes. The Board would then apply to the Local Government Board for sanction to borrow the necessary money, the expenditure being estimated at £4,000.

Mr. H. E. Kershaw moved, and Mr. Hall seconded, that the permission should be granted.

Mr. Moss, Chairman of the Electric Lighting Committee, hoped that the Vestry would consider before acceding to the request. It was not fair to the committee that the Guardians should ask for one of the Vestry's officers to be employed upon such work, and he personally considered that Mr. Russell had quite sufficient to do to look after the electric light station. The proposed expenditure would be a waste of the ratepayers' money, and as an amendment he moved that the Vestry should decline to grant the application, and that they should strongly protest against the extravagance proposed by the Guardians.

Mr. Kershaw asked for permission to withdraw his motion, but this was refused.

Mr. Winkler having seconded the amendment, a long, acrimonious and somewhat personal discussion took place. On a division the amendment was carried by 41 to 30 votes, and it was then adopted as a substantive motion.

We have been enabled to obtain a copy of the scheme proposed for the electric lighting of the cottage homes as elaborated by the Visiting Committee of the Guardians. As the document is of an exceedingly original character, we make no apology for presenting it to our readers. The reasons adduced by the committee in favour of an electric light installation are as follows:—

The Scheme.

1. The engine house, boilers, and plant would form an excellent training school of a very useful and practical kind for the boys electing to go as engineers. Any intelligent lad having served two years in a small station would be capable of earning a commencing salary of £1 per week in a London or country electric light station.
2. Our present engineer, with the assistance of the boys, is competent and able to undertake the running of the plant.
3. The cost of the whole installation computing the money borrowed at 3 per cent. for 30 years would be repaid with interest for £60 to £100 per year only in excess of that paid annually for gas (gas at 4s. 2d. per 1,000).
4. A saving would be effected by using the exhaust steam for heating the bath, stores, and schools; the surplus live steam we could find uses for, such as pumping, heating schools, &c.
5. An anticipated saving may be expected in the present consumption of coal, for the three existing boilers could be dispensed with.
6. No extra labour need be entailed, for by the provision of a battery it will only be necessary to run the station of an evening in the winter and two or three days a week in the summer.
7. The plant is provided for in duplicate, so that in event of breakdown the Homes will not be put in darkness. If, however, your Board think one engine and one boiler with the battery sufficient, a large portion of the cost would be reduced, say, £1,000.
8. It has been often considered a source of danger, the grounds being in comparative darkness during the winter; this will be obviated by the proposed erection of eight arc lamps, as now in Shoreditch.
9. Saving in decorations, more light in the Cottages, double the light in Infirmary and Schools and Grounds.

The Cottages are at present lighted by—

18 8-c.p. gas jets on ground floor.	Now proposed, 7 16-c.p., 11 8-c.p.	in each
15 8-c.p. " upper "	" 15 8-c.p.	cottage.
Schools, 60 12-c.p.	" 60 16-c.p.	
Workshop and stores, 100 8-c.p.	" 50 16-c.p.	
Infirmary, 50 8-c.p.	" 50 16-c.p.	
Official residence, 30 12-c.p.	" 30 16-c.p., 10 8 c.p.	

Grounds, 8 arc lamps, each giving a light equal to about 1,000 c.p.

These figures show 769 points total, and as nothing like half this total would ever be alight all at one time we are safe in assuming a maximum load of 400 16-c.p. lamps, which electrically would give a total possible load of 42 kw., with an average maximum of 30 kw., and the cost would be:—

	£	s.	d.
Two 20-kw. sets, engines and dynamos	900	0	0
One 350-ampere-hour battery	120	0	0
Two meters	12	0	0
Two boilers and setting	500	0	0
One main switchboard	150	0	0
Cost of wiring Cottages, &c., arc lamp posts, &c.	910	0	0
Mains, conduit pipes, road boxes and covers	344	10	0
Laying cable	176	0	0
Buildings and contingencies	887	10	0
	£4,000	0	0

These figures allow very fully in every case, and ample margin is allowed in arriving at these costs. The prices are based upon the contracts now being carried out for the Vestry.

An estimate of Maintenance Account is as follows:—

	£	s.	d.
Two boilers, consuming 100 tons of coal per annum, costing, say	100	0	0
Water	10	0	0
£4,000 repayment, interest and capital	253	6	8
	£363	6	8

Present gas account, £257 per annum.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

18,312. "Improvement in electromotors." M. O. Schmiedel. Dated September 11th.

18,324. "Improved method and means of constructing electric circuits for inter-communication." C Adams-Randall. Dated September 11th.

18,335. "Improvements in electrodes for arc lamps." H. Bremer. Dated September 11th.

18,350 "Improvements in or relating to electrolytes." Q. Marino. Dated September 11th.

18,365. "Improvements in central battery telephone exchange systems." W. Aidken. Dated September 12th.

18,390. "Improvements in ventilating fans of that class which is employed in connection with electric motors." P. M. Justice. (The Emerson Electric Manufacturing Company, United States.) Dated September 12th. (Complete.)

18,414. "Improvements in or relating to electric contacts or current taking devices." E. Greil and E. Audiger. Dated September 12th.

18,438. "Improvements in or relating to the electrolytic deposition of metals." C. V. Burton. Dated September 12th.

18,440. "Improved means of flash signalling by electric light." Sir W. G. Armstrong, Whitworth & Co., Limited, and J. Honner. Dated September 12th.

18,454. "Improvements in electric lighters for pipes, cigars and the like." J. J. Robson. Dated September 13th.

18,457. "Improvements in guards for electric tramcars and other tramway vehicles." J. Tidswell. Dated September 13th.

18,468. "Improvements in electricity meters." Chamberlain & Hookham, Limited, and S. H. Holden. Dated September 13th.

18,489. "Process for forming a conducting connection between electrical incandescence bodies of second class conductors with conductors of the first class." Siemens Bros. & Co., Ltd. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated September 13th. (Complete.)

18,502. "Improvements in safety devices for electrically operated hoisting apparatus." Hans von Kramer. Dated September 13th. (Complete.)

18,531. "Improvements in or connected with overhead trolleys for electric railway vehicles." H. H. Hall and R. J. Urquhart. Dated September 14th.

18,537. "Improvements in or relating to appliances for raising and lowering suspended incandescent electric lamps and the like." J. B. McIndoe. Dated September 14th.

18,539. "The Leach-Prince electrical cable guard for overhead trolley system of electrical tramways." J. Leach, G. Prince and W. Prince. Dated September 14th.

18,547. "Improvements in continuous current electric motors or generators of enclosed type" H. W. Wilson. Dated September 14th.

18,550. "Improvements in armoured insulating conduits and the method of treating same." A. G. Brookes. (A. M. Lougee, United States.) Dated September 14th.

18,555. "Improvements in splicing ears and terminals for overhead electric trolley wires employed on electric tramways." J. Slack. Dated September 14th.

18,564. "Improvements in incandescent electric lamps." H. D. Goatley. Dated September 14th.

18,574. "Improvements in apparatus for wireless telegraphy." F. J. Jervis-Smith. Dated September 14th.

18,576. "An apparatus for ascertaining the direction of electrical waves." A. Polumordvinoff. Dated September 14th.

18,589. "Improvements in the decomposition of alkaline salts by electrolysis, and in apparatus therefor." J. Greenwood. Dated September 14th.

18,598. "Improvements in the manufacture of incandescent filaments for electrical incandescent lamps." R. Haddan. (M. Boehm, Germany.) Dated September 14th.

18,612. "Improvements in the means of attaching shades, globes, reflectors, and the like, to electric incandescent lamp-holders." E. Duckenfield. Dated September 15th.

18,624. "Improvements in and relating to electroliers." S. Ball. Dated September 15th.

18,627. "Jude's single leaf electroscope." R. H. Jude. Dated September 15th.

18,628. "Jude's multiplex connector." R. H. Jude. Dated September 15th.

18,629. "Jude's double leaf electroscope." R. H. Jude. Dated September 15th.

18,680. "Jude's galvanometer or galvanoscope." R. H. Jude. Dated September 15th.

18,648. "Improvements relating to the amalgamation and coating of metals or alloys of metals with metals or alloys of metals by the aid of electricity, and to apparatus therefor." F. H. Snyder. Dated September 15th.

18,664. "Improvements in and relating to electric railways." W. B. Purvis. Dated September 15th. (Complete.)

18,695. "Improvements in or connected with incandescent electric lamps." G. J. Thomson and E. Lee. Dated September 16th.

18,705. "Improvements in or connected with incandescent electric lamps." G. J. Thomson and E. Lee. Dated September 16th.

18,728. "Improvements relating to electrical switches." A. G. W. Baxter. Dated September 16th.

18,741. "Improvements in electric tramways." B. P. Stockman. Dated September 16th.

18,743. "An improvement in separators for the plates of secondary batteries." H. Leitner. Dated September 16th.

18,754. "Improvements in galvanic batteries." P. MEYER. Dated September 16th.

18,756. "Apparatus for generating and utilising electric energy." W. S. SIMPSON. Dated September 16th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1899.

387. "Improvements in and connected with the manufacture of iron wall carriers for electric insulators and other objects." F. Unterberg. Dated January 7th, 1899. Consists in making the bed-plate and feet in one piece by cutting, stamping and pressing the iron for use with electric insulators. 4 claims.

427. "Improvements in electric igniters for gas engines." W. H. Cotton. Dated January 7th, 1899. The energy for the igniter is provided by means of electro-magnets mounted on the cylinder head in combination with an armature. Only one electro-magnet need be used. 7 claims.

580. "Improvements in telephone apparatus." D. H. Wilson. Dated January 10th, 1899. Relates to telephone and transmitter systems. Comprises an induction coil, including a primary and secondary coil; one coil provided with a core having opposed pole pieces, the other coil interposed between such pole pieces, so as to be in the path of the magnetic circuit between the pieces and a transmitter and receiver, connected respectively with the primary and secondary coils. 6 claims.

764. "Hollow or recessed punches used in connection with Wheatstone's automatic telegraphy or other systems of automatic transmission." J. W. Willmot. Dated January 12th, 1899. The heads of the punches are hollow, and thereby a flatter cutting surface is obtained, and compressed air forces out the punched out pieces of paper from the punch. 1 claim.

1,001. "Improvements in and relating to electric heaters." E. F. Forter. Dated January 16th, 1899. Relates to Specification 5,595, of 1891. Consists in mounting the heat generating parts on the blades of a fan. The motor is in circuit with the conductor. 5 claims.

1,627. "Improvements in insulators for fastening electric wires." J. Treleaven. Dated January 24th, 1899. Relates to improvements in wire fastening for insulators. Consists of an insulator having a groove passing half way round near its top, a groove on the opposite side curved downwards and intersecting the opposite ends of the groove, the intersections being angling obliquely to the plane of the groove and means for preventing the insulator from turning when fastened. 1 claim.

1,835. "Improvements in switches for starting and controlling electric motors." H. Hirst and W. Mead. Dated January 26th, 1899. Relates to switches for starting and controlling electric motors, and has reference to the regulation of rheostats. Consists of a spring, box, wheel and pinion, and an electro-magnet, the armature of which acts upon a pinion. 5 claims.

2,610. "Improvements in the manufacture of insulating material for electric cables." G. E. Heyl-Dia. Dated February 6th, 1899. Consists in using as an insulator paper pulp, to which is added non-hygroscopic oils instead of cellulose. 2 claims.

2,780. "Improvement in cut-outs applicable both in the case of fuses and of switches." J. W. Manley. Dated February 7th, 1899. Relates to that type of cut-out in which the metallic strip is affixed to a part detachable from the base and constituting a handle of insulating material. The contact springs are sunk and the tongues are abnormally long. The handle is perforated in a direction normal to the plane of the base. 5 claims.

2,934. "Improvements in or relating to induction coils." M. E. Field. Dated February 9th, 1899. Relates to improvements in medical induction coils. Consists in inserting between the core of the coil and the primary and secondary coils sheet metal which is a good conductor of magnetic lines of force. 8 claims.

3,051. "Electric illuminating apparatus." S. Baner. Dated February 10th, 1899. The spring motor which drives the dynamo is arranged in a small box which is capable of receiving the dynamo, the motion transmitting parts, and an accumulator, and which is enclosed in the foot or in the upper part of the amp. 4 claims.

3,182. "Charging stand and contact for storage batteries." G. H. Condict. Dated February 13th, 1899. (Date claimed for patent under Section 103 of Act, being date of first application in United States, July 18th, 1898.) The table or stand is provided with a number of rocking contact levers which have two arms, one of which carries a yielding or elastic contact at its outer end, the end of the other being upturned. These contacts work automatically and charge the batteries in trays, by making contact with the contact pieces on the tray. 6 claims.

3,189. "Improvements in electric insulators." F. H. Withycombe. Dated February 13th, 1899. Has for its object to lessen the likelihood of insulators being broken. Consists in replacing the smooth outer surfaces of a small protuberance ridges which will break and cushion the force of contact of missiles, &c. 11 claims.

3,367. "Improvements in trolley apparatus for use in connection with electric traction." J. E. Winslow. Dated February 15th, 1899. The object is to provide improved trolley apparatus for use in connection with overhead conductors of electric railways. Consists in combining with the pivoted trolley arm, two or more springs in tandem, and so as to act in multiple. The springs are provided with a case. 5 claims.

3,734. "Improved process for electric smelting or reducing." W. Borchers. Dated February 20th, 1899. Consists in inserting the whole of the carbon intended for the reaction as the resistance into an electric furnace, and packing the substance to be acted on round the carbon without mixing the two, and then passing a strong electric current through the carbon. 2 claims.

3,735. "An improved method of and apparatus for utilising the waste gases and heat from electric furnaces." W. Borchers. Dated February 20th, 1899. Consists in effecting the electric smelting or reduction in the interior of a steam generator in the presence of an excess of the charge which remains undecomposed, freeing the gases generated in the furnace from dust particles by passing them through a filtering medium and then allowing the molten product to cool down in the surface. 7 claims.

3,736. "Improvements in secondary batteries." J. Skwirsky. Dated February 20th, 1899. Consists in the use of electrodes of cylindrical form inserted one within the other around a central electrode, the cylindrical vessel containing all the electrodes of one cell, and being likewise utilised as an electrode. 4 claims.

3,754. "An improvement in electrical wall plugs." P. F. W. Simon and H. P. Berry and C. Rayner. Dated February 20th, 1899. Relates to a wall plug for high tension currents. The plug is suitably insulated and screws on to the wall head connections. 1 claim.

3,774. "Improvements in galvanometers and the like." L. H. Newton, R. R. F. Neville, S. P. Newton and E. Tew. Dated February 20th, 1899. Relates to improvements in a galvanometer. The indicator needle is balanced horizontally, and kept in its normal position by a permanent magnet. Only one coil is used, which is in a horizontal position. 2 claims.

4,118. "Improvements in the mode and means for operating the poles or masts of electrical cars or vehicles for tramways." W. Rutherford. Dated February 24th. Consists of a gravitating carriage or its equivalent attached to the mast and holding a coil in suspension so as to allow an easier transfer from one cable to another. 2 claims.

4,176. "Improvement in the distribution of electricity over electric railways on the series system." M. Cattori. Dated February 19th, 1899. Relates to Specifications Nos. 6,212, 1894, and 20,829, 1895. Consists in an electric railway provided with two parallel sectional conductors, switches by which two adjacent sections may be joined and terminal switches connected to the respective poles of the generator and each arranged to connect one of said poles with the terminal section of either conductor. 5 claims.

4,231. "Improvements in arc lamps." W. C. Johnson and A. Wunderlich. Dated February 25th, 1899. The resistance coil of the circuit consists of a thin band of metal wound round a number of radially arranged insulating bars so that it is exposed to the atmosphere. 7 claims.

4,442. "Improvements in the manufacture of accumulator plates." Dr. W. Majert and F. Berg. Dated March 1st, 1899. Relates to the manufacture of accumulator plates as described in Specification 991, 1897. Consists in giving the tool there described an oscillating motion. 4 claims.

4,699. "An improved ceiling rose for electric lights and the like." H. F. Clayton. Dated March 3rd, 1899. The base of the rose is provided with a passage or channel of zig-zag form for the reception of wires, so that the likelihood of fracture is reduced to a minimum. 2 claims.

4,878. "An improved case for electrical transformer connections, also applicable to street electric light standards." G. Wilkinson. Dated March 6th, 1899. Consists of a box with a hinged and locking door adapted to a transformer, and holding enclosed all high tension connections, in combination with a metal covering having internal attachments, and carrying a concentric cable with or without a metallic tamping for sealing and earthing. 4 claims.

4,957. "Improved electric devices for controlling the power supply of motors and the like." M. K. Bowen and G. W. Knox. Dated March 7th, 1899. Relates to devices for controlling the power supply of motors. Consists of a movable part having suitable contacts, and provided with a retarding device independent of the current and of variations in the force applied in operating the controller. 4 claims.

5,030. "Improvements in control apparatus for electric hoists and elevators." O. Imray. (A. E. Macoun, United States.) Dated March 7th, 1899. Relates to means for automatically slowing down the car of an electric hoist near each end of its travel, and stopping the car always at the same point. Mechanism actuated by the movement of the hoist introduces resistance when the car nears the end of its travel. A hand-worked cut-out switch is connected to the hoist drum, and automatically breaks the main current when the car reaches the limit of its travel. 5 claims.

5,255. "Improvements in electrical switches." R. T. Hall. Dated March 10th, 1899. Consists in interposing between the poles, simultaneous with the breaking of the circuit, a diaphragm of insulating material. 4 claims.

5,513. "Improvements in electric break apparatus." T. B. Kinraide. Dated March 14th, 1899. Comprises a rotating member, an electro-magnet, a break device, and means driven by the rotating member for interrupting said break device. 11 claims.

5,545. "Improvements in induction motors for alternating electric current circuits." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., and C. P. Steinmetz, United States.) Dated March 14th, 1899. Relates to alternating current motor. Consists in arranging a field magnet coil which may or may not be wound on the moving member, and in inductive relation thereto, at such an angle as to produce a rotary effect, a second coil is provided, which may be closed on itself by a switch inserting an adjustable resistance. 13 claims.

5,546. "Improvements in induction motors for alternating electric current circuits." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., and C. P. Steinmetz, United States. Dated March 14th, 1899. Instead of constructing the phase-splitting motors with poles displaced from each other by one quarter of the polar pitch, and exciting one set of the said poles from the single-phase mains, and the other by dephased currents, one main inducing coil and two auxiliary inducing coils are used. 9 claims.

5,547. "Improvements in devices for changing the frequency of alternating currents in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated March 14th, 1899. Consists of a frequency changer composed of two dynamo-electric machines being of the rotary induction type so connected as to supply energy from a system of distribution, connections of one of the machines to a secondary system and means whereby one of the machines is so modified by the action of the other that the current induced in its secondary member and fed therefrom to the secondary system is of a frequency different from the frequency of the current which would normally be induced in it. 6 claims.

5,550. "Improvements in self-starting alternating electric current motors." British Thomson-Houston Company, Limited. (C. P. Steinmetz and E. J. Berg, United States.) Dated March 14th, 1899. Consists of a single-phase alternating current system of electrical distribution, an alternating current motor having exciting windings connected directly to the supply mains of the system, phase modifying devices connected across the said mains and in parallel with exciting windings and other exciting windings connected through phase modifying devices to supply main. 12 claims.

5,551. "Improvements in devices for starting alternating electric current motors." The British Thomson-Houston Co., Ltd. (C. P. Steinmetz and E. J. Berg, United States.) Dated March 14th, 1899. Consists mainly of an alternating current motor having main and supplemental induced windings, the main windings being directly connected to the supply lines of the system phase modifying devices connected to the lines in parallel with the main induced winding and connecting the supplemental windings to the supply lines. 6 claims.

5,570. "Improvements in closed conduits for electric railways and trolleys therefor." A. M. Clark. (The Campbell Electric Traction Company, Incorporated.) Dated March 14th, 1899. Consists in a conduit containing a continuous conductor, and having a non-conducting cover grooved in its under side metal plates in the groove, and insulated from each other, and outside sectional conductors each connected with one of the metal plates. 8 claims.

5,576. "Improvement in automatic systems of preventing collisions on electric railways." C. F. Bancroft and P. F. Sullivan. Dated March 14th, 1899. Relates to automatic systems of preventing collisions on railways specially applicable to single line track provided with turnouts. Consists of means whereby the passing of a car along a section of line will shut off the power from another section of the same. 5 claims.

5,619. "Improvements in or applicable to galvanic batteries." F. E. Singer. Dated March 16th, 1899. Relates to an improved method of preparing the carbons of galvanic batteries. Consists in preventing a deposit on the electrodes through chemical action by coating the carbon with a thin layer of cement. 2 claims.

5,868. "Improvements in connection with the sheathing or casing of thermo-electric elements." J. Y. Johnston. (Hartmann & Braun, Germany.) Dated March 17th, 1899. Consists of a protecting sheathing for thermo-electric elements consisting of fire-resisting material with a longitudinal hole therethrough traversed by a rod or tube capable of resisting high temperatures. 3 claims.

6,067. "An improved electrical drying apparatus for treating textile fabrics." J. M. J. E. Vignon-Dante. Dated March 20th, 1899. The heat necessary is obtained through electric energy transferred to caloric. The heating apparatus is enclosed by the drying apparatus. 3 claims.

6,269. "Improvements in electric lampholders." R. F. Hall. Dated March 23rd, 1899. Consists in the employment of metallic nipples to which the ends of the circuit or lead wires are secured, and which carry attached spring plungers adapted to contact with the filament terminals of the lamp. 2 claims.